FEASIBILITY STUDY
FOR THE
SNCFR TELECOMMUNICATIONS
AND MARKET ENTRY PLAN

FINAL REPORT

PRESENTED TO:
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EXECUTIVE SUMMARY

This Final Report is one of the deliverables of the Feasibility Study of the SNCFR Telecommunications and Market Entry Plan, which is funded by a grant from the U.S. Trade and Development Agency (TDA). The primary objective of the feasibility study is to prepare a strategic implementation plan aimed at SNCFR's successful entry into the growing Romanian telecommunications market as a licensed service operator offering a competitive service to the public in a soon-to-be fully de-regulated market. This report highlights market, technical, management, regulatory, business, partnering, and financial issues related to SNCFR's potential entry into the commercial telecommunications market of Romania.

With a population of nearly 23 million people, but an estimated telephone service penetration rate of only 15.4% in 1998, Romania is a telecommunications market with substantial potential for growth. The sole provider of basic telecommunications services is the state-owned monopoly, Rom Telecom. Its aging analog network and bloated bureaucratic structure have been unable to meet the demands for telecommunications services. Over a million potential subscribers sit on a waiting list for telephone service.

Yet even with its low service penetration, Rom Telecom was able to generate over $550 million in revenues from its 3.1 million subscribers in 1996, the last year for which data is available. The majority of this revenue came from business subscribers, even though they comprised only 11% of total customers. In fact, Romania's ratio of business subscribers to residential customers is one of the lowest in the Central and Eastern European region, indicating a market potential that has been largely untapped.

In order to raise national levels of telecommunications service to average European Union (EU) standards and to fulfill its commitments to the World Trade Organization (WTO), the Government of Romania has declared that Rom Telecom's monopoly would end at the end of 2002 - thereby, opening the market to competition from other telecommunications providers.

With financing supplied by the World Bank and the Romanian Government, SNCFR is in the process of completing a 3,600 kilometer state-of-the-art fiber optics network that covers most of the cities in Romania and interconnects with

other railways' telecommunication systems in neighboring countries, Rom Telecom, and an international switch in Bucharest. It is scheduled to be in full operation by the end of the year 2000. Components of the system have been appropriately designed for application beyond the Railway's internal telecommunications needs. If proper financial return is expected to be generated for repayment of the World Bank loan, then this excess capacity must be effectively utilized by providing service to customers external to the Railway.

At the same time, SNCFR is being reorganized into an infrastructure company (CNCF), a freight operating company, a passenger operating company, and two smaller administrative companies. Responsibility for and ownership of the telecommunications functions and assets are being placed with CNCF. TERA has recommended an organizational structure for a new telecommunications organization (ATCFR) within CNCF.

Five alternative business strategies have been analyzed for commercializing the Railway's telecommunications assets.

(1) **"Lease the right-of-way"** - The Railway would not directly enter the commercial telecommunications market, but would lease its surplus capacity and right-of-way to an independent outside party.

(2) **"Go it alone"** - The Railway, through its telecom agency ATCFR, would serve the internal telecommunications requirements of the SNCFR Companies (the Passenger Company, Freight Company, Infrastructure Company, and other non-operating companies of SNCFR) and would enter the commercial telecommunications business without a business or investment partner.

(3) **"Form a limited joint venture"** - ATCFR would take care of the Railway's own internal telecommunications needs and would contribute as equity the surplus fiber optic capacity to a new joint venture company (JVCo). JVCo would sell telecommunications services to the external commercial market only, and would be owned by the Railway, one or more experienced foreign and domestic operating partners, and perhaps other passive financial partners.

(4) **"Form a full joint venture"** - ATCFR would contribute as equity the entire fiber optic system to JVCo. As in Alternative 3, JVCo would be owned by the Railway, by one or more experienced foreign and domestic operating partners, and perhaps by other passive financial partners. ATCFR, as subsidiary of the Railway's Infrastructure Company (CNCF), would remain responsible for providing telecommunications services to the SNCFR Companies. JVCo would market telecommunications services to the external market. JVCo would also provide backbone communications services to ATCFR.

(5) **"Form an outsourcing joint venture"** - Alternative 5 is similar to Alternative 4 except that JVCo, instead of ATCFR, would be directly responsible for providing basic telecommunications services to the SNCFR Companies. ATCFR would, however, continue to provide the Railway with radio and circulation security telecommunications services.

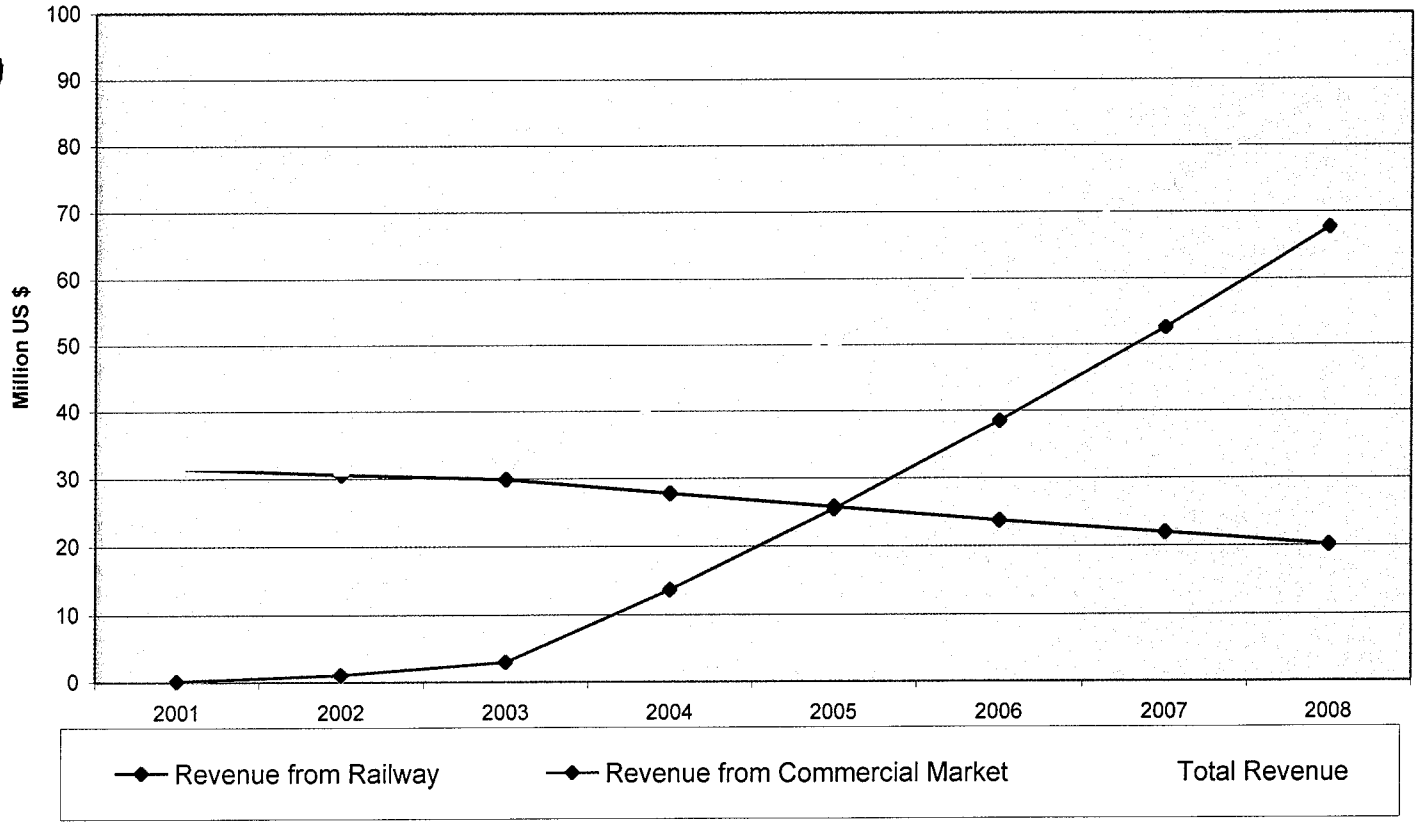
Alternative 5 has been recommended as the approach best suited to meet the Railway's internal telecommunications needs as well as most successfully capitalize on external commercial telecommunications operations. Assuming this alternative is adopted by SNCFR, the following table summarizes the projected financial performance of JVCo for the years 2001 through 2008. Depending on the financing source for funding additional system expansion, the internal rate of return ranges from 22% to 26%.

Projected JVCo Profit and Loss Statements

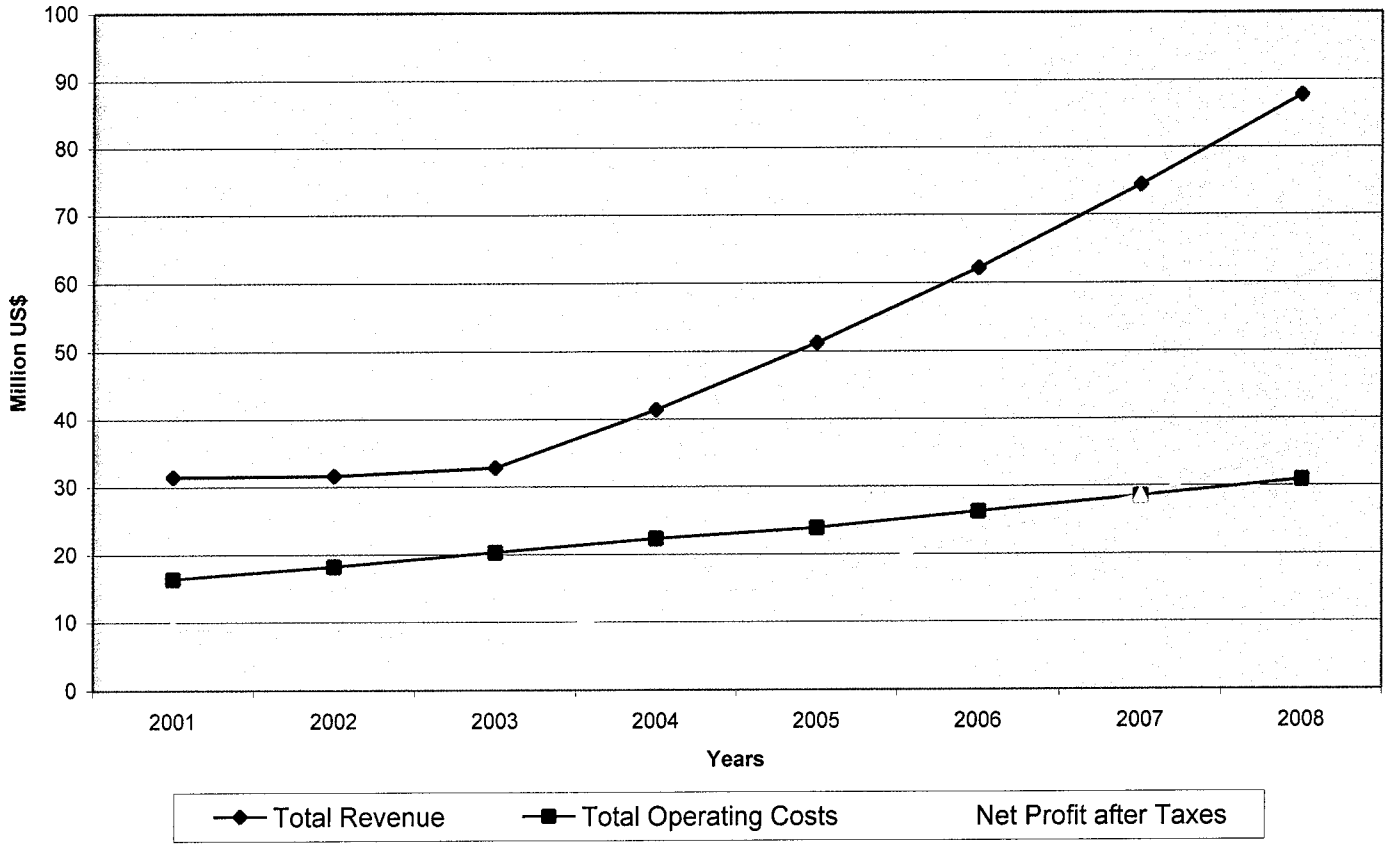
(All figures are in million US Dollars.)

	2001	2002	2003	2004	2005	2006	2007	2008
Revenue:								
Railways	31.4	30.5	29.8	27.7	25.7	23.7	21.9	20.1
Commercial	0.0	1.0	2.9	13.6	25.4	38.4	52.5	67.6
Subtotal	31.4	31.5	32.7	41.3	51.1	62.1	74.4	87.7
Operating Costs	16.3	18.1	20.2	22.2	23.8	26.1	28.4	30.8
Profit before Taxes	15.0	13.4	12.5	19.0	27.2	36.1	46.0	56.9
Corporate Taxes	5.7	5.1	4.7	7.2	10.3	13.7	17.4	21.6
Profit after Taxes	9.3	8.3	7.7	11.8	16.9	22.4	28.5	35.3

Projected JVCo Revenue Breakdown



JVCo Profit and Loss Projections



SECTION 1:
INTRODUCTION

A. PROJECT BACKGROUND

This Final Report by Transportation and Economic Research Associates, Inc. (TERA) is presented to Societatea Nationala a Cailor Ferate Romane (SNCFR) as one of the deliverables for the Feasibility Study of the SNCFR Telecommunications and Market Entry Plan. The Feasibility Study is funded by a grant from the U.S. Trade and Development Agency (TDA).

The primary objective of the feasibility study is to prepare a strategic implementation plan aimed at SNCFR's successful entry into the growing Romanian telecommunications market as a licensed services operator offering a competitive service to the public in a soon-to-be fully de-regulated market.

The study consists of the following 8 tasks:

Task 1: Market Issues
Task 2: Technical Issues
Task 3: Financial Issues
Task 4: Management Issues
Task 5: Business Plan
Task 6: Partnering Issues
Task 7: Regulatory Issues
Task 8: Final Report

Individual Task Reports were presented to SNCFR at the completion of each task. The results of the first seven tasks are integrated and presented in this Final Report.

TERA's investigation included extensive interviews, observation of SNCFR's telecom facilities and processes, and comprehensive review of SNCFR and public documents. From these sources and TERA's experience and observations in other countries, various statistical inferences and managerial recommendations have been developed for SNCFR.

In this first Section of the report, background information on Romania and an overview of global telecommunication trends and the Romanian

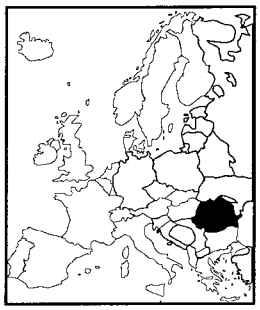
telecommunications sector are presented. The purpose of this Section is to present the relevant geographic, economic, and sectoral background so that the market issues reflecting SNCFR's telecommunications business potential and market entry strategies can be placed in an appropriate context of market size and characteristics.

The other Sections of this report focus on market issues (Sections 2,3,and 4), technical issues (Section 5), management issues (Section 6), regulatory issues (Section 7), business and partnering issues (Section 8), financial issues (Sections 9 and 10), and a projected joint venture structure and financial performance (Section 11).

B. COUNTRY BACKGROUND

Geography and Population

Romania is located in the south eastern section of Central Europe in the Lower Danube basin, north of the Balkan Peninsula and bordering on the Black Sea. The country is bounded by the Black Sea on the southeast, by Bulgaria on the south, the former Yugoslavia (bordering only Serbia) and Hungary on the west, and by Ukraine and Moldova on the north and east.



Romania covers an area of 237,499 square kilometers (91,699 sq. miles) - slightly smaller than Great Britain or the U.S. state of Oregon. Its terrain is roughly equally divided between mountains (31 percent), hills (33 percent), and plains (36 percent). Romania's climate is temperate: Cold, cloudy winters with frequent snow and fog; sunny summers with frequent showers and thunder storms. Average temperatures are considerably colder in the mountainous north and central regions than in the milder southern and eastern plains.

About 89% of the country's people are ethnic Romanians, with the principal minorities consisting of Hungarians and Gypsies. Romania's official language is Romanian, a romance language which evolved from the Latin used in the ancient Roman colony of Dacia. Against her Slavic and Hungarian neighbors, only Romanians have successfully preserved their Eastern Roman heritage and language throughout history. Romanians are the sole descendants of the ancient Eastern Roman world and their language, along with Spanish, French and Italian, is an off-spring of Latin.

With a population of nearly 23 million, Romania is the second most populous country in Central and Eastern Europe, and is larger than 10 of the present 15 members of the European Union (Table 1-1).

Romania is a country of significant potential - having rich agricultural lands; diverse energy resources (coal, oil, natural gas, and hydro); a substantial, if aging, industrial base covering a full range of manufacturing activities; an intelligent well-trained work force; and opportunities for expanded tourism development on the Black Sea and in the mountains. Its future progress is dependent on its continued political and economic development.

Table 1-1: 1996 Population (Million)

Country	Population
Germany	81.9
United Kingdom	58.8
France	58.4
Italy	57.3
Spain	39.3
Romania	**22.6**
Netherlands	15.5
Greece	10.5
Belgium	10.2
Portugal	9.9
Sweden	8.8
Austria	8.1
Denmark	5.3
Finland	5.1
Ireland	3.6
Luxembourg	0.4

Source: The World Bank, ***1998 World Bank Atlas***, Washington D.C., USA, 1998, pp. 24-25

Government and Political Environment

As Christians of Orthodox rite, Romanians lived since the Middle Ages in three neighboring independent principalities of Moldavia, Transylvania, and Wallachia at the crossroads of expansionary empires of Ottomans, Czarist Russians, and Hapsburgs. Despite these empires, the three Romanian principalities managed to preserve their cultural and ethnic identity, faith, and civilization. The process of national unity, which started in 1859, was eventually completed by 1918, when the three principalities were combined under a single monarchial democracy.

The independent state of Romania existed for 22 years, until 1940, when, at the outbreak of World War II, one-third of Romanian territory was occupied by Germany. At the end of the war, the occupation of Romania by Soviet troops in 1945 and the forcible imposition of a communist regime ended Romania's short-lived monarchial democracy. In December 1989, the totalitarian regime of Nicolae Ceausescu, the last Romanian communist dictator, was toppled by the People's Revolution.

The 1989 Revolution created conditions for the final breakaway from the communist regime, which ruled Romania for 45 years, and paved the way for restoration of a multi-party democracy based on individual freedoms and a market economy. The adoption of the new Constitution on November 21, 1991 and the free parliamentary and presidential elections of May 1990 and September 1992 were significant accomplishments on the path to the irreversible breakaway from the totalitarian past.

Romania is a constitutional republic with a multiparty parliamentary system. The Parliament is bicameral - the lower house is the Chamber of Deputies and the upper house is the Senate. The President, elected by universal suffrage, serves for a 4-year term. The presidency is non-partisan under the terms of the Constitution. The head of the government is the Prime Minister. The President designates a candidate for the office of Prime Minister following consultation with the political parties represented in the Parliament. The candidate for Prime Minister and his cabinet must be approved by the Parliament in a vote of confidence before they can assume office.

Presidential and parliamentary elections were held most recently in November 1996. Emil Constantinescu was elected President in a run-off with 54 percent of the vote. The reform program proposed by Constantinescu and his Prime Minister, Victor Ciorbea of the National Peasant Party, was widely lauded by international financial institutions and analysts. It included a program to privatize state-owned enterprises (SOE), liberalize the economy, and accelerate the country's integration into the European Union (EU). High on the government's agenda were reforms in the key areas of agriculture and financial policy, and the completion of price liberalization.

However, many of the promised reforms failed to materialize (largely due to coalition in-fighting and bureaucratic barriers to change), and the economic condition of the country turned out to be much worse than anticipated by the government. The situation reached a crisis point in January 1998 when the Social Democrats left the ruling coalition and refused to back the proposed budget. The crisis led to Ciorbea's resignation in March 1998. Since then, the Social Democrats have returned to the government and are supporting the efforts of the new Prime Minister, Radu Vasile, who, like Ciorbea, is of the National Peasant Party.

Economy

The economy inherited from the pre-1989 totalitarian regime was characterized by ubiquitous socialist property ownership, excessive centralization, rigid planning, low productivity, imbalanced emphasis between manufacturing and service sectors, and over-investment in uneconomic, energy-intensive, and environmentally undesirable manufacturing. In order to reduce Romania's foreign debts and establish its credibility with the international financial community, arbitrary measures were taken in the 1980s under Ceausescu to reduce imports and promote exports without regard to economic efficiency. Between 1975 and 1989, Romania's communist regime paid over $21 billion of its foreign debts, to the detriment of fiscal and economic stability. This policy deepened the emerging economic crisis and significantly compromised the quality of life and standard of living.

The first democratically elected government, established after the elections held on May 20, 1990, took measures for transition to a market economy, including the dismantling of centralized economic institutions, converting state-run enterprises into autonomous entities (*regies autonomes*), liberalizing prices for most consumer goods, encouraging foreign investments, and enacting new laws of privatization. The energy and raw material crises of the early 1990s, coupled with a decrease in investments, repeated labor conflicts, problems in the implementation of a land privatization program, high inflation, and a dramatic drop in exports deteriorated the economic situation during the early transition period.

Table 1-2 illustrates the general performance of the Romanian economy from 1990 to 1997. The early steps in free market economics were hampered by the fact that much of the old power structure remained in place under a new name. The general idea for personal freedoms and a market economy were defined, but the institutional structures and extensive Government ownership of the elements of the economy impeded change. Rising rates of inflation and unemployment characterized the economy up to 1994.

Table 1-2: Selected Economic Indicators, 1990-1997

DESCRIPTION	1990	1991	1992	1993	1994	1995	1996	1997
GDP (in million $US)	857.9	2,204.0	6,029.0	19,733.0	48,338.0	35,300.0	35,520.0	31,400.0
Exchange Rate (lei/$, end of year)	34.7	189.0	460.0	1,276.0	1,655.1	2,628.0	4,130.0	8,030.0
Labor Force (millions)	10.9	10.8	10.8	10.5	10.1	10.5	10.4	10.4
Unemployment Rate (percent)	Unk.	3.0	8.4	10.2	10.9	9.5	6.3	9.0
Trade Balance (million $)	-1,720.4	-1,345.0	-938.0	-711.5	-402.0	-1,600.0	-2,500.0	-1,700.0
Foreign Debt (mil. $, end of year)	230.0	1,143.0	2,354.0	3,334.0	4,410.0	6,800.0	9,100.0	10,400.0
ANNUAL CHANGE OF SELECTED INDICATORS (PERCENT):								
Consumer Price Index	5.1	174.5	210.9	256.1	136.8	27.8	56.9	90.0
Exports	-41.5	0.5	14.2	4.0	30.6	33.8	2.5	8.6
Imports	50.5	-6.9	1.9	-5.5	20.6	50.7	11.5	-1.4

Source: Data for 1990-1993 from Cosmos, Inc., ***Romania Economic Newsletter;*** Vol.4, No.1, Special Insert, April-June 1994; Bethesda, MD: p. 1. Data for 1994 from Romanian Development Agency, ***Romania Encyclopedic Survey;*** Bucharest, Romania: undated and Coopers and Lybrand/Romanian Development Agency; ***Romania Yes! An Investment Guide;*** Bucharest, Romania; October 1995: Appendix 1, p. 99.; Data for 1995-1997, National Trade Data Bank and Economic Bulletin Board, U.S. Department of Commerce, ***1997 Country Report on Economic Policy and Trade Practices: Romania***.

The elections of November 1996 brought a more liberalized government into office, led by the National Peasant Party. Popular dissatisfaction with the previous pace of reform, and the consequences of that slow pace, was one of the main reasons why the elections produced a change in the political landscape. The new leadership ran on a platform of privatizing state-owned enterprises (SOEs), liberalizing the economy, and accelerating the country's integration into the European Union (EU). The new government, formed by a 4-party coalition, began by strongly encouraging privatization of the economy and set about establishing the policies and institutions needed to bring this about. Two key elements of these privatization plans pertained to the State-owned railway (SNCFR) and the State-owned telecommunications monopoly (Rom Telecom).

Prospects for securing a stable macroeconomic environment improved following the government's launch of its economic program in mid-February 1997. With the key first steps implemented in February, March, and April, the IMF was then able to secure approval by its Board of a 13-month Stand-by Arrangement in April 1997 of $430 million. Among the key measures in this program were: liberalizing the foreign exchange market; sharply tightening monetary policy; eliminating directed credits from the National Bank of Romania; and reducing the fiscal deficit.

In addition, in June 1997, the World Bank approved three loans totaling $550 million in support of the Romanian Government's economic reform program. The three loans - a $50 million Social Protection Adjustment Loan, a $350 million Agricultural Sector Adjustment Loan, and a $150 million loan for a Second Roads Project - were designed to provide the government with financial resources to fight poverty and cushion the social cost of reforms, while pushing ahead with economic stabilization measures. Since 1990, World Bank loan commitments to Romania have totaled approximately $2.5 billion.

Romania's privatization program was originally launched in 1991 with the enactment of the Privatization Law. This law established a state ownership fund (SOF) and five private ownership funds (POF), which were created as state-controlled joint stock companies (JSCs). Under this law, the SOF received 70% of shares in about 6,400 commercial companies while the other 30% went to the POFs for further distribution to the Romanian citizens under a voucher system. A bankruptcy law was passed in March 1995, but because large state companies, or *Regies Autonomes*, were exempt from this law, arrears in payments continued.

By August 1997, approximately 3,800 enterprises had been privatized. The private sector accounted for about 55% of Gross Domestic Product (GDP) in 1997, up from 35% in 1994. Employment originating in the private sector rose sharply, from 23% in 1995 to 47% in 1996. In 1997, the private sector accounted for 52% of foreign trade.

On April 15th, 1998, the Romanian Parliament gave overwhelming approval (by 317 votes to 124) to the new Prime Minister, Radu Vasile, and his Cabinet and to a program of accelerated reform drafted by the new government. The main elements of the program are lower inflation; faster privatization and restructuring of state enterprises, banks, and utilities; rehabilitation of the agricultural sector; and preparations for accession to the EU membership. Pressing ahead with restructuring and privatization of the economy have become a matter of urgency.

Investment Climate[1]

According to the Ministry of Privatization, the flow into Romania of foreign direct investment (FDI) reached $1.7 billion. This compares with a cumulative total of $2.1 billion at the end of 1996, and implies that last year's FDI increased the total registered foreign investment between 1989 and the end of 1995 by almost 50 percent. This figure is expected to come out higher than those in comparative country studies produced by non-government and multilateral agencies because, among other methodological differences, they include the full amount of foreign revenue from privatization (approximately $600 million for 1997), and are expected to refer to new commitments, rather than disbursements. The Ministry of Privatization has projected that FDI will exceed $2 billion in 1998.

Since 1990, Romania's policy has been to encourage foreign direct investment. To this end, a substantial body of legislation has been enacted to create a favorable investment climate. However, the cautious attitude on the part of foreign investors during the period between 1990 to 1993 reflected uncertainties over political stability, concern about productivity, and fears of inadequate return on investment. After an increase in investment in 1994 and 1995, capital inflows decreased in 1996 as investors awaited the results of the November elections. The new reform-

[1] This sub-section was adapted from the Briefing Book prepared for the U.S. TDA sponsored ***Crossroads of the World*** Conference held in Istanbul, Turkey on May 27-29, 1998.

minded government puts strong emphasis on the role of foreign capital, and has promised to remove the remaining structural barriers to foreign investment. The result may very well be a sharp increase in both direct and portfolio foreign investment.

The legal framework for foreign investment in Romania is provided by the following laws:

- Commercial Register Law (No. 26/1990; revised in 1997)
- Commercial Company Law (No. 31/1990)
- Foreign Investment Law (No. 35/1991; revised 1993 and 1997)
- Accountancy Law (No. 82/1991)
- Free Trade Zones Law (No. 84/1992)
- Value Added Tax (Ordinance No. 3/1993, as amended)
- Local Taxes (Law No. 27/1994)
- Government Ordinance Regarding Tax on Profit (No. 70/1994)
- Law on stimulating Foreign Investment in Industry (No. 71/1994)
- Privatization Law (No. 55/1995)
- Bankruptcy Law (No. 64/1995)
- Petroleum Law (No. 134/1995)
- Copyrights and Neighboring Rights Law (No. 8/1996)
- Competition Law (No. 21/1996)
- State Monopolies Law (No. 31/1996)
- Bank Privatization Law (No. 83/1997).

This body of legislation ensures that foreign investors are granted national treatment, have free access to domestic markets, and are allowed to participate in the country's privatization programs. There is no limit on foreign participation in commercial companies. Foreign investors are entitled to establish wholly foreign-owned enterprises in Romania (although joint ventures are the normal pattern) and to convert and repatriate 100 percent of their after-tax profits. They are allowed to participate in the management and administration of the investment, as well as to assign their contractual obligations and rights to other Romanian or foreign investors. Foreign investments in Romania are governed by the provisions established by the Foreign Investment Law in force at the time of incorporation, unless a subsequent law contains more favorable provisions.

Foreign investors may engage in business activities in Romania in any of the following ways:

- Set up new commercial companies, subsidiaries, or branches, either wholly-owned or in partnership with Romanian natural or legal persons;
- Participate in the increase of the registered capital of an existing company or the acquisition of shares, bonds, or other securities and instruments of debt issued by such companies;
- Acquire concessions, leases, or agreements to manage economic activities, public services, or the production of sub-units belonging to commercial companies or state-owned public corporations;
- Acquire ownership rights over non-residential real estate improvements, including land, via establishment of a Romanian company;
- Acquire industrial or other intellectual property rights; and
- Conclude exploration and production-sharing agreements related to the development of natural resources.

Foreign investor participation can take the form of: foreign capital, equipment, means of transport, spare parts and other goods, services, intellectual property rights, know-how and management expertise, or proceeds and profits from other businesses carried out in Romania.

Financial Sector[2]

The banking system has undergone major restructuring in Romania's transition toward a market economy. Key elements have been the transformation of the National Bank of Romania (NBR) into a traditional central bank and the development of a network of commercial banks. The Law on Banking Activity (Law 33/1991) and the NBR Statutes (Law 34/1991) established the legal framework for banking in Romania.

[2] This sub-section was adapted from the Briefing Book prepared for the U.S. TDA sponsored ***Crossroads of the World*** Conference held in Istanbul, Turkey on May 27-29, 1998.

Performance has been mixed in the banking sector. According to an assessment by NBR, the banking system is fundamentally sound, but there are some individual banks that are financially and institutionally weak. Of Romania's forty licensed banks, seven are state-owned. Of the state-owned banks, the top five account for approximately 60 percent of aggregate assets and more than 70 percent of commercial loans. But with the passage of the new Bank Privatization Law in the spring of 1997, the privatization process for state-owned banks has now begun. In addition, several major foreign banks have opened offices in Bucharest, playing an important role in setting new service standards and supporting the functioning of the foreign exchange market. The government is also committed to privatizing at least two of the state-owned banks during 1998, with more to follow.

Elsewhere in the financial system, progress has been made in capital market development. The Bucharest Stock Exchange (BSE), whose trading focuses on shares of large enterprises, had increased only modestly until this year. It has been joined by a new exchange, the RASDAQ (modeled on its North American counterpart, the NASDAQ). Over the medium-term, it is hoped that the RASDAQ will act as a source of new capital for growing businesses. Activity in both the BSE and the RASDAQ has risen sharply this year. By late spring 1997, weekly turnover on the exchanges was often in excess of the annual turnover of the previous year. Separately, credit cooperatives have carved out an increasingly large market niche providing member-based financial services.

C. GLOBAL TELECOMMUNICATION TRENDS

Access Levels

On a global basis, the trends in telecommunication have all become focused on increasing the quantity and quality of telephone and data exchange services. As the twentieth century comes to a close, there remain vast differences in access to telecommunications throughout the world. The most common measure of telecommunication access is teledensity - the number of main telephone lines per 100 inhabitants. In 1996, teledensity ranged from .07 in Cambodia to 99 in Monaco, which indicates the wide range of telecommunications development around the world.

The size of the world's telephone network has grown more than eightfold over the past 37 years, from less than 100 million main telephone lines in 1960 to nearly 800 million by the end of 1997. While the global growth rate in main telephone lines has been relatively constant over the past 40 years, it is instructive to review the three periods of main telephone line growth and identify those countries and regions which made major strides in enhancing tele-accessibility.

During the first period, Japan stands out. Between 1960 and 1977, Japan saw its teledensity rise almost eightfold from 3.9 to 30.6. Telephone waiting lists were practically eliminated and the country entered a new phase of development, shifting from quantity to quality. Innovative financing was a major factor contributing to Japan's rapid telecommunications growth. Subscriber bonds purchased by customers when their telephones were installed were used to help finance the large investment program.

During the second period, from 1975 to 1985, the Republic of Korea, Singapore, and Taiwan saw their telecommunications access rise dramatically. They demonstrated that the transition from a teledensity of 10 to 30 could be completed more rapidly than previously thought, as a result of learning from experiences elsewhere as well as technological change. Although few countries have been able to subsequently imitate this rapid increase in access, it demonstrates that it is possible.

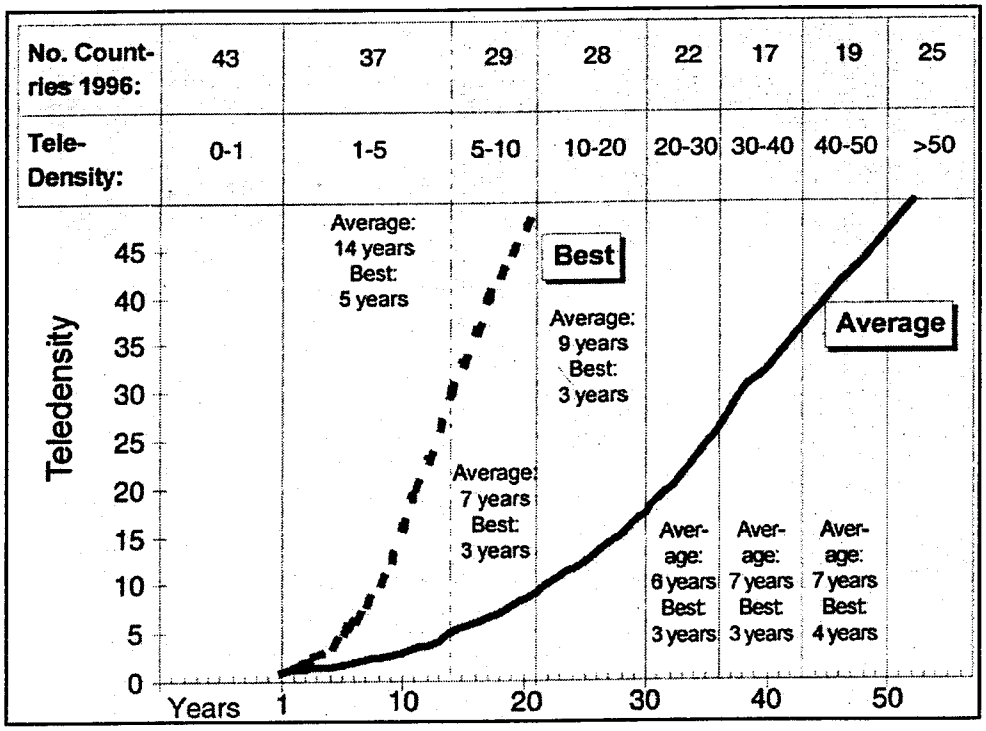
The third period, particularly from 1990 on, has been marked by rapid growth in a number of developing countries. In Latin America, countries that privatized their telecommunication operators have generally done well. Argentina almost doubled its teledensity from 9.5 to 17.7, while Chile and Venezuela lifted their teledensity to over 10. East Asian countries also achieved impressive results, the most noteworthy being China. China contributed one-fifth of the 300 million or so global lines added during the period 1990-1997, raising its teledensity from below 1 to over 5.

Despite the giant strides that a number of countries have taken, there remain immense variations between regions and countries. Furthermore, the period of time required to attain a high level of teledensity is still relatively long (Figure 1-1).

One quarter of the countries still have a teledensity below one (i.e. less than 1 telephone line per 100 inhabitants). Until a country has passed this threshold, it is

virtually impossible to predict how long it will take to reach higher levels. After attaining a teledensity of one, it can then take between 20 and 50 years to reach a teledensity of 50, a level reflecting high telecommunications development. However, one encouraging sign is that as a country's teledensity rises, the number of years to reach the next level is shortened. For example, while on average it takes 21 years to get from a teledensity of one to 10, it takes about nine years to move from 10 to 20. The downside of this, unfortunately, is that while virtually every one of the countries have increased access, those at high levels have increased their level of teledensity more than those at low levels. The result has been to accentuate the gap between high and low teledensity countries.

Figure 1-1: Teledensity Timetable (Years)



Note: "Average" refers to the mean number of years taken by countries which have made the transition from one teledensity category to another. "Best" refers to best practice, in terms of the shortest length of time taken. It is logically not possible to provide an average transition length for 0 to 1 as many countries still have a teledensity of less than one. **Source:** International Telecommunication Union, ***World Telecommunication Development Report 1998***.

Access Strategies

In telecommunications strategies globally, sector change has increasingly been seen as a way to inject rapid growth into the national telecommunications market, thereby improving access. For a number of developing economies - mainly Latin America, Central and East European countries, and also more recently in some African states - privatization has been the most significant transformation in the telecommunications sector. Privatization of the national operator provides capital and management know-how for building up the network.

Privatization has had an initial positive impact upon network growth and access. One reason is that network expansion targets have increasingly been made a requirement of privatization concessions (Table 1-3).

Table 1-3: Network Expansion Requirements for Privatized Telephone Companies, Selected Countries

Country	Company	Date	Requirement
Ghana	Ghana Telecom	1996	♦ Provide a minimum of 225,000 new telephone lines within 5 years.
Mexico	Telmex	1990	♦ Average annual main line growth of 12% per year between 1990-94. ♦ Payphones to be installed in each town of population greater than 500 by 1994. ♦ Public payphone density to be 2 per 1,000 inhabitants by 1994 and 5 per 1,000 inhabitants by 1998.
Panama	Cable and Wireless (formerly called INTEL)	1997	♦ Increase teledensity to 25% by 2002. ♦ Install 600 rural payphones within 2 years
Peru	CPT and Entel	1994	♦ Add 978,000 main lines between 1994-98 (distributed between metropolitan and provincial areas) ♦ Install 19,000 public telephones by 1998. ♦ Provide public service to all towns larger than 500 persons by end-1998.
Venezuela	CANTV	1991	♦ Increase main lines by 335,000 per year, 1992-2000.
South Africa	Telkom	1997	♦ Increase main lines to 6 million by 2002. ♦ Install 120,000 public pay phones by 2002.

Source: International Telecommunication Union, ***World Telecommunication Development Report 1998.*** Geneva, Switzerland; March 1998: p.71

In Mexico and Argentina, targets included in the licenses for the privatized companies required a combination of annual network growth and coverage achievements. In Mexico, Telmex - in which a strategic stake was sold to foreign investors in 1990 - was required and achieved an average annual growth rate in main telephone lines of 12% through 1994. In Argentina, the two new operators created from the privatization of the government-owned Entel in 1990, were required to install sufficient lines to achieve an average network growth of 6% in the first five years. Growth achieved was in fact closer to 14%.

The impact of privatization is more recent in Central and Eastern Europe. The two Baltic countries, Estonia and Latvia, partially privatized their telecommunication operators in 1992 and 1994 respectively, while the Czech Republic and Hungary began privatization processes in 1993. Since privatization, the latter two countries have ranked among the top in the region in terms of teledensity, household penetration and payphones (Table 1-4).

Table 1-4: 1996 Teledensity Levels - Selected Countries

Country	Teledensity	Household Penetration (main lines per 100 households)	Payphones (per 100 inhabitants)
Bulgaria	31.26	55.6	1.46
Czech Republic	27.31	46.9	3.39
Greece	50.87	98.1	3.98
Hungary	26.06	55.6	3.98
Poland	16.91	41.5	1.75
Romania	**13.98**	**38.5**	**1.06**
Russia	17.54	40.5	1.30
Slovak Republic	23.19	48.5	2.37
Turkey	22.36	79.1	1.01
Ukraine	18.09	39.2	1.08

Source: International Telecommunication Union, ***World Telecommunication Development Report 1998.*** Geneva, Switzerland; March 1998: World Telecommunication Indicators.

The potential of privatization to increase network development in Africa, where stakes in four incumbent operators were sold between 1996 and 1997, is immense.

Ghana Telecom, 30% of which was sold to a strategic investor in December 1996, must install 225,000 lines in 5 years. If this target is met, it will triple teledensity, raising it from 0.5 in 1996 to almost 1.5 by the end of the year 2001. In South Africa, 30% of Telkom was sold in March 1997. Telkom must install 2.8 million new lines also within five years. One outcome would be that at least half of the households that can afford telephone service, would have their own individual telephone. Côte d'Ivoire-Telecom, 51% privatized in January 1997, will install 300,000 telephone lines over a five year period, quadrupling the number of lines at the time of privatization.

There has been a gradual opening of the local telecommunication markets in order to attract new operating companies to increase the supply of telephone lines. A limited number of countries have awarded licenses to provide competitive fixed-line local services while other countries have introduced indirect competition through the licensing of new mobile cellular operators. In other cases, licenses are issued to new telecommunication operators to provide service in a specific region or using a specific technology, such as wireless local loop (WLL).

The impact of new market entrants is particularly evident in the Asia-Pacific region where more than 80 new companies have been formed since 1990. In the Philippines, for instance, 5 new mobile cellular licenses were awarded in 1993 with the requirement to also install 400,000 new fixed-line link lines over a 5-year period, while 7 international gateway licenses were awarded with the obligation to install 300,000 new fixed-link lines over a 3-year period. This policy calls for 4 million new lines to be installed across the country by 1999, quadrupling the number of lines.

In Bangladesh, a locality-specific approach was adopted by awarding a license to a joint venture between the Bangladesh Rural Telecommunication Authority and the U.S. company, International Communications Technologies, to install 123,000 lines by 1999. The 25-year operating license, restricted to the rural north of the country, covers a region of almost 70 million inhabitants with a current network of only 7,000 lines. In Sri Lanka, a technology-specific solution was adopted by awarding licenses to two new operators to provide local service using WLL technology. The operators, Telia Lanka and Lanka Bell, are each required to install 100,000 lines.

In Central Europe, local exchange operating licenses have been issued to new companies in Hungary and Poland. The Hungarian government awarded concessions for local service in 23 out of 25 regions in 1994. The incumbent, Matáv, was awarded five regions plus a further two for which no bids were received. The remaining regions are to be provided service by new local telephone operators. By 1996, the new operators were operating around 20% of all telephone lines in the country. Poland has also awarded concessions for local operators in rural areas. In order to encourage new operators, the government allows joint ventures with foreign strategic partners (as in Hungary) and assists with financing for operators that cannot afford start-up costs. New local exchange operators in these countries have also received financial support from the World Bank's private financing arm, the International Finance Corporation, which established a private investment fund for that purpose in May 1994.

A number of developing countries are adopting policies which call for the installation of telephones in unserved localities, primarily rural villages and towns. Because of the immense task and cost of wiring all localities, priority is generally given to "strategic" localities (based for example, on size of population or proximity to border areas). Some countries, such as Malaysia and Turkey, have successfully provided service in all villages while countries such as Thailand have concrete plans to do so.

One strategy is to mandate operators to install telephones in localities without service. In Mexico, Telmex's 1990 license required it to install at least one telephone with long-distance service in all towns with a population greater than 500 prior to the end of 1994.

Other countries are pursuing a strategy focusing on specific rural projects. Thailand is one country that has had a four phase program that began in 1974 to increase telephone access in rural areas.

A further way to increase the number of localities with telephone service has been to license specific rural operators. In Ghana, Capital Telecom was established in 1994 to provide telecommunications to the rural southern part of the country. Despite a number of technical, financial, and regulatory difficulties, service began in February 1997. About 10,000 lines will be provided in the first phase.

Special funds can also be used to finance telecommunication development in rural areas. In Poland, where 35% of the population is rural, the "Telephonization Project for Rural Localities Having No Telephone Lines" was started in 1991 to install at least one telephone line in each locality without service. Over 7,885 localities were connected between 1992 and 1996, with funding of $20 million coming from the state budget.

D. TELECOMMUNICATIONS REFORM IN ROMANIA

In 1991, the Romanian government launched a 15-year (1991-2005) program to expand and modernize the country's telecommunications system. Targets for the year 2005 include:

- Increasing the average penetration rate from 11% to 30% (7.2 million lines for a population of 23 million);
- Creating a national digital network;
- Developing the microwave network and encouraging radio link solutions;
- Improving basic services provided to rural areas; and
- Encouraging the development of value-added services.

The estimated value of the program was set at $10 billion. During its first seven years of implementation (1991-1997), Romania's telecommunications modernization program has produced some impressive results:

- Local and transit digital exchanges have been installed in major cities, bringing the total number of telephone lines to 3,400,000 of which 970,000 are digital. The average telephone density reached 15.3 % (30% in urban areas, but only 4% in rural areas, where some 2,000 villages still have no telephone service at all).

- Four joint ventures have been established (with Siemens, Alcatel, Goldstar, and Telrad) to manufacture digital switching equipment locally. The first two manufacture high capacity public telephone exchanges (EWSD and E 10 B type equipment), while the latter produce small capacity exchanges for rural areas and PBX's.

- The construction of a digital overlay network consisting of fiber-optic cables and digital transmission equipment is almost completed. Of a planned total of 10,000 km of cable, 7,000 km have already been installed. Eight main transit switching exchanges, which form a national backbone, have been linked to the country's 40 administrative centers.

- Significant private investment, Romanian and foreign, has been made to develop data transmission, mobile communications, radio/TV broadcasting, and value-added services. At the beginning of 1998, the private sector included 2 operators of data transmission networks, 2 GSM operators, 24 trunked radio operators, 12 paging operators, 166 Value-Added Service suppliers, 162 local radio stations, 72 local TV stations, 5 radio broadcasters via satellite, 4 TV broadcasters via satellite, 9 VSAT operators, more than 400 CATV operators, and 8 suppliers of data transmission services via CATV.

Major projects for the 1998-2000 period include:

- Further expansion of the GSM cellular system (about 700,000 new subscribers, for a total of 1 million in the year 2000).

- Implementation of the DCS 1800 system. Two licenses (worth $25 million each) will be granted by the end of 1998: one to Rom Telecom and one to an operator to be selected via international tender.

- Expansion of digital wireless local loop (WLL) systems. This project aims at increasing telephone density in rural areas and in busy urban environments. Of the new lines to be installed by Rom Telecom, about one-third are expected to use WLL systems. Pilot projects by private companies are encouraged in order to help select the most adequate technologies. Build-transfer arrangements will be preferred.

- Expansion of the intelligent payphone network. About 10,000 payphones will be installed in 1998. They will adhere to regional standards and will use Eurochips.

- Launching ISDN (using the already existing switching system and related transmission paths). It will be supported by the installation of SS7 signaling system.

- Installation of a second international digital switch (to be located in the city of Brasov). The switch will ease congestion on the existing switch located in Bucharest and will expand the capacity of Rom Telecom's international connectivity.

- Expansion of Internet services. The existing internet backbone will be upgraded by Rom Telecom via the implementation of a frame relay over the ATM network.

- Expansion of the national television's TVR-2 public channel. This will be achieved by using new digital transmitters enabling the TVR-2 channel to broadcast in stereo NICAM system.

- Upgrading the national radio spectrum management system.

Pending Legislation in the Romanian telecommunications sector includes the following:

- Rom Telecom privatization. In accordance with the Romanian Government's general policy of creating a market economy, Rom Telecom, one of the country's largest monopolies (53,000 employees and more than 3 million subscribers), is slated for privatization. By Government Decision No. 673/1997, Rom Telecom, formerly having the legal status of a public corporation, was turned into a joint-stock company with the State as the sole shareholder. By the end of 1998, about 35% of Rom Telecom's shares are expected to be sold to a strategic investor selected, via international tender, from among the leaders of the world's telecommunications market. The selling of shares to a strategic investor will generate funds which will enable Rom Telecom to upgrade its activity and increase its market value, as a prerequisite for full privatization. It is expected that around the year 2000, Rom Telecom will start selling the balance of its shares on the free market.

- Radiocom privatization. Legislation is being drafted on turning Radiocom into a joint-stock company as a first step towards its privatization. The method of privatization is expected to be similar to the one adopted for Rom Telecom.

- Creation of a National Telecommunications Agency, an independent body which will take over the current regulatory functions of the Ministry of Communications and the General Communications Inspectorate.

- Creation of a National Frequency Monitoring Center.

Currently in Romania, the existing telecommunications market is monopolized by the Government-owned Rom Telecom. Rom Telecom has the right to all public, land-based telecommunication services and owns and operates this essential piece

of the Romanian infrastructure. Service is reported to be poor, prices to be high and yet there is a backlog of over a million potential subscribers.

In this environment, the Government has loosened the strings to allow competition for data services (essential for business growth), cellular services (to partially overcome backlog of demand), and licensed services in rural areas where Rom Telecom often has no service at all. The telecommunications environment is scheduled to change even further in the year 2003 when Rom Telecom will officially lose its monopoly protection and the market will be opened to free competition.

As further discussed in Section 3, on the External Telecommunications Market, later in this report, the Romanian government has set an ambitious policy of increasing the telephone subscriber penetration rate to 30% of the population by 2003. This figure is taken as one of several guidelines for Romania's entry into the EU. It is thought that this penetration level is going to be difficult to meet without large amounts of additional capital, improved management skills and entry of competitors into the telecommunications market.

The low level of development of the Romanian telecommunications system is being partially met by the granting of licenses to two GSM cellular operators one of which is partially owned by Rom Telecom. Satellite operators have also entered the market for specialized services such as banking data networks. A more complete listing of Romanian telecom operators and the Government Agencies responsible for telecommunications is included in Appendix 1-A. More operators, such as these, are likely to enter the market, but none of them solve the central problem of overcoming the obsolescence and years of deficient investment in Romania's basic telephone system. ***SNCFR's modern telecommunications system, just commencing installation, is uniquely positioned to help fill this gap***.

Along with the privatization initiatives, it is planned that the Government's involvement in the telecommunications industry will be somewhat reduced. The Ministry of Communications, which has been the owner and operator of Rom Telecom and Rom Radio may be abolished with the privatization of its operational responsibilities. However, a provision for regulation in an otherwise free market would be fulfilled by transfer of powers to the General Communications Inspectorate (GIC). Thus rates, services, licensing, control of radio frequencies and enforcement of open competition will be under Government oversight.

The enforcement of open competition will be particularly important. Under a Romanian law of January 19, 1998, openness of interconnections between major suppliers is assured. There are also safeguards against anti-competitive practices such as cross-subsidization, anti-competitive use of information obtained from competitors and withholding timely technical and commercial information from other service suppliers when necessary for interconnected service.

E. SNCFR TELECOMMUNICATIONS ASSETS

Outside the existing public telecommunications market, SNCFR operates a parallel, countrywide private telecommunications system. The system is the second largest in Romania and has 35,000 subscribers. After Rom Telecom, SNCFR has the only other land-based telecommunications system that effectively blankets the entire country. Significantly, SNCFR also owns contiguous rights-of-way throughout Romania.

SNCFR's telecommunications system, however, is old and outdated. It is as if a generation of development, under the centrally planned economy, has passed it by. It is based on analog transmission through buried copper cables, aerial lines, and obsolete, electro-mechanical step-by-step switches. Furthermore, the system is filled to capacity and is incapable of carrying the high volumes of data transmission required for the operation of a modern railway administration.

SNCFR has addressed this situation with a detailed plan to upgrade its telecommunications system into a 3,600 km fiber optic (FO) transmission system with modern digital switches. The upgrade came as a result of a SNCFR study approved by the World Bank. The financing for the telecommunications upgrade is provided by:

- The World Bank through a credit for acquisition of components, equipment, and materials; and

- The Government of Romania for costs associated with installation, customs and other taxes.

The study looked into the telecommunications requirements of the Railway and recommended the construction of a new fiber optic digital transmission network

and a new digital switching network with integrated services. This upgrade is expected to provide new telecommunications facilities, which SNCFR so badly needs to support and carry on its railway telecommunications operations. The fiber optic (FO) cable has been purchased with the help of a World Bank loan. The initial deliveries of FO cable started in February 1998, with installation to follow. The transmission equipment for the expanded system was bid in June 1998, and advertisement for bids for the system's digital switches are to go out shortly for closure at the end of 1998.

SNCFR has already been operating a successful 62 km pilot FO installation for the last four years on the critical line section between Bucharest and Ploiesti. This pilot section uses SDH (Synchronous Digital Hierarchy) and PDH (Plesiochronous Digital Hierarchy) transmission equipment and is performing according to specifications.

SNCFR's fiber optic system is comprehensive, well planned, and should be in full operation by 2000, three years before the sunset of Rom Telecom's monopoly. The system will have available an approximate 50% excess capacity (10 fibers). At that point, SNCFR will have one of the highest quality telecommunications systems in Romania and the one most suited for secure data transmission and modern business uses. The system will also include integrated high quality voice, data, and video capabilities. ***With the freedom of interconnection between telecommunication systems, SNCFR can become an important supplier of Romanian telecommunications services.***

APPENDIX 1-A

List of Telecommunications-Relevant Organizations in Romania

May 1998

ROMANIAN TELECOMMUNICATIONS SECTOR

A. REGULATORY ENTITIES

MINISTRY OF COMMUNICATIONS
Blvd. Libertatii 14, Bucharest
Minister: Sorin Pantis
Tel. (40-1) 400-1100; Fax: (40-1) 400-1329
State Secretary: Dumitru Moinescu (Strategy)
State Secretary: Dan Chirondojan (Regulations)
Director General for Strategy: Gabriel Grecu
Tel. 400-1734; Fax: 312-5642
Director General for Regulations and Licenses: Corneliu Sterian
Tel. 400-1575; 400-1555 (William Liska); Fax: 400-1230
Director for Int'l Cooperation: Paul Fischer, Tel. 400-1210, 400-3330
Director for Int'l Relations: Marcela Mustata
Tel. 400-1737, 781-5535; Fax: 400-1556
Comment: Main regulatory entity

GENERAL COMMUNICATIONS INSPECTORATE
Splaiul Independentei 202 A, Bucharest
Director General: Bogdan-Cristian Iana
Technical Director: Ion Matei
Tel: (40-1) 400-1421, 411-0643; Fax: (40-1) 312-4797
Comment: Enforces telecommunications regulations, licenses and authorizations; controls and certifies compliance with technical standards; manages radioelectric frequencies; monitors frequency spectrum.

NATIONAL BROADCAST COUNCIL
Blvd. Libertatii 14, Bucharest
Chairman: Mircea Moldovan
Tel. (40-1) 411-3547; Fax: (40-1) 312-4634
Comment: Issues licenses for broadcasting companies

B. PUBLIC OPERATORS (State-owned)

ROMTELECOM
Blvd. Libertatii 14, Bucharest
President: Vlad Tepelea, Tel. (40-1) 400-1026, Fax: 410-5581
Director General: Florin Anghel
Tel. (40-1) 400-1212; Fax: (40-1) 400-1002
Director for Development: Silviu Agapi, Tel. 400-1081
Technical Director: Dumitru Anghelescu
Commercial Director: Corneliu Radu Moldovan
Tel. 400-1202; Fax: 312-6390
Director for European Integration: Emilia Dumitru
Tel. 410-1202; Fax: 410-1145; GSM: 094-587919
Director for Foreign Trade: Ecaterina Bogdan
Tel. 400-3335; Fax: 400-1888
Director for IT: Constantin Prunaru, Tel. 400-2746
Head of Marketing Dept.: Lidia Toboc
Tel. 400-1518; Fax: 400-1742
Comment: Has the monopoly of wired telephony. Provides basic services, voice circuits, leased lines, telegraph and telex. Also provides value-added services (videotex, facsimile, e-mail, teletext, telemetry, etc.) on the free market.

RADIOCOMUNICATII (RADIOCOM)
Blvd. Libertatii 14, Bucharest
Director General: Stefan Molinaru
Tel: (40-1) 400-1101; Fax: (40-1) 400-1228
Technical Director: Mircea Predut, Tel. 400-3746
Comment: Provides radio and TV broadcasting support, operates microwave communications networks and satellite (Intelsat, Eutelsat) earth stations.

TELEFONICA ROMANIA
"Union" Trade Center, 2nd floor, Bucharest
President: Florin Rusu
Tel: (40-1) 312-1853; 312-1594; Fax: (40-1) 312-2857
Commercial Director: Valeria Bara, Tel. 312-1413
Comment: Owned by Romtelecom (80%) and Radiocom (20%). Designs, installs, and operates the Telemobil (450 MHz) cellular telephone system. The network has 22 base stations and two switching centers. Ericsson equipment.

C. PUBLIC OPERATORS (Privately-owned)

MOBIFON S.A.
City Business Center, Str. Nerva Traian 3, Bl. M101, Bucharest
President and CEO: Al Tolstoy
Chief Technical Officer: Jean Tripier (Assistant: Cristina Parvu)
Tel. (40-1) 302-2901, 302-2904; Fax: (40-1) 302-1444, 302-1001
Vice President, Customer Service: Marie-Sophie Duchesne
Tel. 302-1300, 302-1333 (Assistant Iuliana Rata)
Comment: International consortium including Telesystem International Wireless Services - Canada, AirTouch Communications - U.S., and private Romanian companies. Operates the "Connex" GSM network.

MOBILROM S.A.
Hotel Dorobanti, Bucharest
President: Andrei Chirica
CEO: Pierre Matei, Tel. 203-3465
CFO: Bernard Moscheni, Tel. 203-3455, Fax: 203-3456
Director, Customer Care: Bianca Zathureczky
Tel. (40-1) 203-3810; Fax: (40-1) 203-3413
Comment: International consortium including France Telecom, Alcatel Network Romania, et al. Operates the "Dialog" GSM network

LOGIC TELECOM
Blvd. Dimitrie Cantemir 1, Bucharest
President: Traian Stanescu, Tel: (40-1) 321-3635; Fax: 321-3730
Technical Director: Dan Stanescu
Commercial Director: Gabriel Petrescu
Comment: Owned by Thai investors (Ucom GSM Co.). Operates LOGICnet commercial data communications network; offers nationwide data services (X.25, VSAT, Internet) and worldwide connectivity via BT/Concert. Importer of Scientific Atlanta satellite communications VSAT equipment and software. "Connex" and "Moldpac" shareholder.

GLOBAL ONE COMMUNICATIONS ROMANIA
Sos. Fabrica de Glucoza 11-13, Bucharest
Director General: Alain Prulliere
Tel. (40-1) 310-2222; Fax: 310-2223
Financial Director: Tiberiu Sandu
Comment: JV between Global One (51%) and Romtelecom (49%).

Provider of "Rompac" data transmission services (X.25, Internet, Frame Relay) and international carrier (voice transport for Romtelecom via Sprint network). Has 6 main nodes and 60 access points.

DIGICOM
Splaiul Unirii 6, Bl. B3A, Et. 4, Bucharest
President: Liviu Tudor
Director General: Leonard Ursache
Commercial Director: Bogdan Iugulescu
Tel. (40-1) 330-4621/22; Fax: (40-1) 330-4258
Comment: Provides data transmission services via VSAT (hub built with Hughes Network Systems; more than 300 terminals installed); digital TV distribution; Internet distribution; and Euteltrucks GPS services.

RADIONET
Blvd. Ion Campineanu 24, Sc. 4, Ap. 127, Bucharest
Director: Constantin Botescu
Tel: (40-1) 210-6869; Fax: (401-) 312-5897
Comment: Romanian-American JV. Operator of conventional repeaters and trunked systems. Motorola distributor.

RADIOTEL (Romanian-American [Dorel Nasui] JV)
Blvd. Dinicu Golescu 37, Sc. C, 4th Floor, Bucharest
Director General: Nicolae Dobre
Tel: (40-1) 638-6177; Fax: (40-1) 223-2640
Comment: Provider of paging, trunking, and Internet services; Connex GSM dealer, Motorola dealer

COMUNICATII NATIONALE MOBILE
Sos. Oltenitei 105, Bucharest
Director General: Bruce Crandall
Tel: (40-1) 312-6746; Fax: (40-1) 312-6706
Comment: JV betrween Radiocom and Metromedia. Provider of paging and trunking services.

BEL PAGETTE ROMANIA SRL (Romanian-Canadian JV)
Str. Sf. Ecaterina 2, Bucharest
Director General: Valentin Bujor
Tel: (40-1) 312-5010; Fax: (40-1) 312-1330
Comment: Provider of paging services.

AMERICANATELL
Str. Emanoil Porumbaru 88, Bucharest
Director General: Mihaela Calinoiu Constantinescu
Tel. (40-1) 223-1101; Fax: 223-2298
Comment: Operator of voice mail

CABLE VISION OF ROMANIA
Blvd. 1 Mai 211-213, Bucharest
Director General: Dinu Malacopol, Tel. (40-1) 400-1826
Comment: Romanian-American JV (Romtelecom + Crystal Ship Corp.) Cable TV operator.

ROMSAT CABLE TV & RADIO
Sos. Oltenitei 105, Et. 11, Bucharest
Director General: Dan Basangeac, Tel. 330-9516; Fax: 330-9517
Regional Director: Stuart Roberts
Comment: Owned by Metromedia. Provider of wireless cable TV services.

KAPPA
Str. Dr. Nicolae Paulescu 9, Bucharest
Owner and Director: Ovidiu Crisan
Tel /Fax: (40-1) 410-9422
Comment: Cable TV operator; Internet service provider; data transmission services; service integrator.

D. AGENTS/DISTRIBUTORS

MOTOROLA
Financial Plaza (Calea Victoriei 15), Sc. E, Et. 4
Corporate Branch Manager: Daniela Andreescu
Tel. (40-1) 310-4252; Fax: 310-4253; GSM 092-277877
Comment: Motorola representative office

AGEXIMCO (Romanian-American JV)
Blvd. Kogalniceanu 15, Et. 7-8, Bucharest
Director: Simion-Stefan Nasui
Tel: (40-1) 312-2849, 311-3043; Fax: 312-1024
Comment: Distributor of Motorola equipment.

UNIAXIS
Blvd. Magheru 1-3, Et. 4, Bucharest
President: Gurkan Gokce, Tel: (40-1) 311-0556; Fax: (40-1) 312-5070
Manager: Lucia Serban, 092-277001
Comment: Distributor of Motorola radiocommunications equipment.

ROKURA LTD. (Romanian-Japanese JV)
Str. Pitar Mos 20, Bucharest
President: Cristian Georgescu
Tel. (40-1) 211-1650 (thru 59); Fax: 210-5201
Comment: Distributor of Motorola cellular and paging equipment

AT & T GIS CEE GmbH
Str. Paleologu 4, Apt. 1, Bucharest
Office Director: Sorin Cristescu, Tel./Fax (40-1) 312-6693
Program Director: Dan Celenti
Comment: AT&T representative office

AMTEL S.A.
Str. Ion Campineanu 2, et. 5, Bucharest
Chairman: Kenneth Blatt, Tel: (40-1) 312-5831; Fax: 312-6120
Comment: AT&T Distributor

INTERACTIVE COMMUNICATIONS T&I
Str. Stirbei Voda 170, Bd. 10G, Et. 8, Ap. 30-31, Bucharest
President: Iulian Herscovici
Vice Presidents: Radu Lupu, Liviu Zins
Directors: Catalin Avram, Pompiliu Mihai
Tel/Fax: (40-1) 312-4356, 222-1963
Comment: Distributor of Harris Digital Telephone Systems

AGNOR HIGH-TECH COMMUNICATIONS & COMPUTERS
Str. Mihai Eminescu 124, Building A, Apt. 3, Bucharest
President: Eugen Preotu, Tel. 211-8800, 8699, 8762; Fax: 210-5943
Comment: Romanian-American JV. Wireless telephony and computer network integrator. Direct importer.

DATA PLUS COMMUNICATIONS
Str. Pitar Mos 2-4, Bucharest
President: David Albeanu, Tel. (40-1) 311-1102; Fax: 312-2788
Comment: Romanian-American JV. Distributor of Mitel telephone

systems, Centigram voice mail systems, video conference systems, etc.

ORLANDO TELECOM
Calea Floreasca 169, Et. 5, Cam. 501, Bucharest
Director: Theo Basch
Tel. (40-1) 230-0108, 230-0109; Fax: 232-2951
Comment: Telecommunications equipment integrator specializing in wireless technology (Comsat Plexis, California Microwave)

PROJECT MANAGEMENT SERVICES
Str. C.A. Rosetti 14, Apt. 13, Bucharest
President: Florin Gheorghisor
Tel./Fax (40-1) 659-0106; GSM 092-200610
Comment: GTE representative

SECTION 2:
MARKET ISSUES -
SNCFR'S INTERNAL TELECOMMUNICATIONS

A. EXISTING TELECOMMUNICATIONS NEEDS

A major part of the existing SNCFR telecommunications system is old (over 30 years) and is in need of replacement with modern state of the art equipment. The system needs more facilities to meet present and future demand for more circuits. The maintenance on this old equipment is high and most spare parts are unavailable. The Telecommunications Department of SNCFR has 2,941 maintenance people working to keep the system operational.

Transmission Network Cable and Transmission Equipment

The interurban cable network has been built during the last 33 years when electrical traction was introduced. The physical condition of the copper cables is gradually deteriorating in parallel with the quality of telecommunications over the telephone cables. The causes of cable deterioration and low transmission quality are mainly as follows:

- Deferred maintenance in some segments.
- Lack of necessary materials for current maintenance.
- Cable deterioration by nearby construction activity.
- Insufficient capital investment for periodic general repairs and replacement.

Practically all the cable circuits are occupied and in need of emergency repairs. The aerial lines are generally very old with needed general repairs not executed on time. These lines become noisy when they get wet.

The multiplex transmission system is an old analog network that is 100% occupied with operational channels. The original equipment manufacturers have stopped their support of this type of carrier equipment.

The interurban cable network consists of 6,506 km of underground copper cables. The cross-section of copper pairs in the main toll areas is 38 with reduced amounts on branch lines. The toll areas have 7 or 8 cable multiplexers each with a capacity cross-section greater than 126 vocal circuits. Every physical circuit on the copper pairs is used for dispatcher lines, telephone lines, data lines, and various railway telecommunications services. The urban cable network consists of 5,114 km of copper cable and is similarly filled to capacity. The aerial lines extend for 4,776 km. Approximately 562 maintenance personnel maintain these systems.

Private Automatic Branch Exchange (PABX)

There are 176 telephone exchanges with an installed capacity for 33,201 subscriber lines with 26,387 subscribers in operation. These switches could support more than 6,800 additional subscribers if interurban trunk lines were available. The existing switches are now supported by 6,181 trunk lines. The average value of the total traffic per subscriber is 0.17 erlangs (busy hour traffic). This means that the 6,181 trunk lines should handle the busy hour traffic with an acceptable call-blocking factor. However, the subscribers get through only about 40-60% of the time mainly due to the following reasons:

- Difficulty in establishing connections, especially interurban ones.
- Frequent interruption of already established connections.
- Unfinished connections, reverse busy tone or busy tone.
- Wrong number connections.
- Difficulty of exiting to the public network.

The 176 switches are partially old of which 112 are old step-by-step type switches. All need replacing. The World Bank upgrade will replace 149 of these switches and keep 27 in service. Some of the replaced equipment will be used for spare parts to maintain the 27 which will remain in service. Some 286 maintenance personnel maintain the telephone exchanges.

Radio Network

SNCFR has a station-to-train radio system that has one radio base station at each railway station and one mobile radio on each locomotive with two frequencies assigned to the system. The frequencies are 146.200 MHz and 146.225 MHz. Each locomotive can switch to either of these two frequencies at anytime. The base stations are assigned one of these frequencies for a route (A) and the other frequency for a different route (B) where parts of it are near route (A). SNCFR's Infrastructure Department radio network contains 3,353 fixed radio stations which are installed in 1,334 railway stations. Each railway station has installed from 1 to 18 fixed radio stations for different system and local operations. The fixed radio stations are spaced approximately 30 km apart.

SNCFR's Infrastructure Department has 6,725 portable radios. They also have 732 mobile radios on locomotives, track maintenance machines, and cars, and 3,353 fixed radio stations for a total radio count of 10,810 of which 9,310 need replacing. The radio network is maintained by 195 maintenance personnel.

The Traction Department has 2,040 radios for 1,800 locomotives. They also have 50 fixed radios and 100 portables. All the radios in the Traction Department may need to be replaced. The total radio count for both Traction and Infrastructure Departments is 13,000.

Data Transmission System

SNCFR uses its data transmission network as support for information interchange between the eight Railway Regions and other important railway nodes. The transmission protocol is X.25 and the system contains 41 nodes in a mesh topology that permits alternative routing for data transmission between any two nodes even in the case of temporary failure of one piece of equipment.

The data transmission network is structured on several speed levels (9,600 bps, 14,400 bps, 19,200 bps, 64 Kbps, and 2 Mbps) depending on the data transmission volume and on the data communications line capacity. The 9,600 bps, the 14.4 Kbps, and 19.2 Kbps data streams operate through modems over the old copper cable/carrier system. Over the fiber optic digital system between Bucharest and Ploiesti, 64 Kbps and 2 Mbps operate. Over a pair of circuits on the local copper cables, only the 64 Kbps streams operate.

Ericsson has built the equipment for the packet data network to the International Standards Organization (ISO) recommendations for Open System Interconnections (OSI). This data transmission network contains about 800 ports and is maintained by 12 personnel. The system will be integrated into the new IRIS (Integrated Railway Information System) data network, which awaits the full installation of the new fiber optic transmission network expected to be completed in the year 2000.

B. PLANNED SYSTEM IMPROVEMENTS

Overview of System Improvements

The SNCFR telecommunications system is being upgraded as a result of a SNCFR study approved by the World Bank. The financing for the telecommunications upgrade are provided by:

- The World Bank through a credit for acquisition of components, equipment, and materials; and
- The Government of Romania for costs associated with installation, customs, and other taxes.

A new fiber optic cable transmission network will be built along 3,535 kilometers of the railway right-of-way and will be able to supply the necessary channels for expanded applications. The new digital system will provide for high-speed data applications for the new IRIS program. New digital exchanges will switch high quality voice, data, and image lines to the desired locations.

The new system will eliminate all of the major deficiencies of the existing old system in transmission and switching. Sufficient high quality digital channels will be available for any application the Railway is considering, including voice, data, teleconferencing, radio base station, dispatcher lines, and signaling control circuits. The plan is to integrate the following systems into the digital transmission system within the project implementation time frame:

- The new digital switching network, using ISDN switches and operating both in digital and analog environments.

- Various types of voice terminals, data terminals and ISDN terminals.
- Operational voice communications network.
- Packet Switching Network (X.25/Frame Relay).
- Dedicated (leased) lines for high-speed data links.

The following systems will be integrated with the digital transmission system after its commissioning:

- Train radio system,
- Video conferencing system,
- Video monitoring system,
- Multimedia and broadband applications, and
- GSM-R.

Some video/broadband applications will be provided with the initial installation. Additional capability in this area will be installed when funds are available for future system growth.

Fiber Optic Cable and Transmission Network

The optical fiber backbone network will be installed along the railway main lines. Some of the rail lines are double track, electrified with standardized 25 KV/50Hz and have relay interlocking and automatic block systems. Fiber cable does not react to electrical or electromagnetic interference and can therefore be installed close to the high voltage electrified rail lines. Aerial cable will be installed on the same concrete poles as the electrified section catenary lines. A large portion of the cable installation will be aerial (2,400 km) with the remainder being installed underground.

The optical fiber cable will contain a cross-section of twenty single mode fibers. The Railway will retain approximately ten of these fibers for its own use and the other fibers will be used for external market applications. The Railway's fibers can carry many times the initial circuit configuration if wavelength division multiplexing (WDM) is applied to the 1550 nm window and/or the 1310 nm window. Also, future technology should create STM-64 equipment soon. STM-64's U.S. counterpart, the OC 192 Sonet equipment, is already being installed in the United States. STM-64 has four times the bandwidth of STM-16 equipment.

The optical fiber backbone network will interconnect the eight regional Railway headquarters with the Administration Center of SNCFR in Bucharest. The network will be made up of four interconnected two-fiber rings, one metropolitan ring, four local rings, four main branches, seven branches, four appendages, fifteen local point-to-point SDH links and several local point to point 2 Mbps links. Future fiber transmission installations could add six additional rings to the network for a total of ten interconnected rings. (Maps of the planned network and recommended ring extensions can be found in Section 5, Figures 5-1 p. 98 and 5-2 p. 103, where these are analyzed in greater detail).The rings connect to each other at two points and are self-healing in case of a fiber cable cut or equipment failure. The 62 km section of fiber cable between Bucharest and Ploiesti is already installed and operational.

The synchronization of the SDH network of SNCFR must be of high quality to run the switching and data transmission networks. The transmission network will use a synchronization architecture based on GPS (Global Positioning System). An external clock is necessary for SDH network elements to derive their transmission timing and therefore transmit synchronously.

The digital transmission network of SNCFR will have a Network Management Center (NMC) in Bucharest and two Regional Management Centers (RMC) located in Cluj and Iasi. These centers will be manned 24 hours a day to handle transmission system problems.

The transmission equipment (SDH and access) shall provide a range of facilities including drop/insert and cross-connect of standard PDH and SDH hierarchy tributaries and drop/insert at 64 kbps channel level. The SDH network should also serve as a video distribution media by employing Video Codec interfaces. The transmission network should be able to support future services especially related to interconnection of different networks.

SDH network availability for tributaries and higher levels shall be better than 99.995%. The mean time between failures (MTBF) for each plug-in unit of SDH equipment shall be at least 35 years and for any SDH network element it will exceed 3 years. The transmission equipment (SDH and PCM) shall have an operational lifetime of at least 15 years.

SNCFR plans to keep the existing copper cable transmission system as a backup and to use some of its parts to maintain the branch line systems.

Digital Switching System

A new digital switching system will replace the majority of the old step-by-step type switching equipment. These switches will be placed on 3,600 km of fiber optic facilities and on an existing analog medium of 7,800 km. The switched network will interconnect with a digital transmission network and the existing analog transmission network. There will be two service levels offered:

(1) Digital services between two users both on digital mediums, and

(2) Exclusive voice service if one or both users are on analog medium.

At the digital level, the switching network will integrate voice, data and video communications, introducing multiple services that are accessible from any digital point and incorporating management functions (supervisory and administration). The railway integrated telecommunications network will be interconnected with other public networks and with neighboring railway networks. The main characteristics of the future railway telecommunications network will be:

- Digital network with all integrated railway telecommunications services;
- Compliance with ITU-T and ETSI recommendations for hardware and software; and
- Adaptable, flexible, reconfigurable and modular (expandable) components.

The integrated network will be used by the Railway employees, clients of SNCFR transport services, other non-railway users whose activities are connected to SNCFR operations.

The users will be able to use the following types of terminal equipment:

- Analog telephone sets,
- Digital telephone sets,
- ISDN telephone terminals,
- Telefax terminals,
- Videotext terminals,
- Data terminals, and
- Personal Computers (PC).

The network will be capable of voice, data and video communications; special services, including value-added; and will be able to support railway-specific applications.

The integrated network will offer the following set of services:

- Standard services (telephony, telex, telefax, etc.);
- Data transmission services (with circuit switching);
- Video services (videotelephony and videoconferencing); and
- Value-added services (email, file transfer protocols, and internet).

Voice connections will be possible between two telephone sets of any kind, two analog fax terminals of any kind, while the telephone sets or the telefaxes can be part of two different networks.

Data connections will be possible between a PC terminal with another terminal or PC; main computer (host); LAN network; peripheral equipment; and other data networks or between two LAN networks.

Video connections will be possible between two videophones and two or more videoconference terminals.

The railway switching network will be interconnected and will operate with the following networks:

- Public network in automatic input/output system;
- Railway telephone networks of neighboring countries;
- Public data network with X.25 package switching;
- Other X.25 networks (private);
- The X.25 networks of neighboring railway administrations; and
- UIC package switching network (Hermes or ulterior) for applications as Transinfo, Interfrigo, Intercontainer, docimel, etc.

Digital Switching Network

The Railway's digital network with integrated services will have architecture on four levels:

Level 4	International	1 digital switch
Level 3	Transit	approximately 8 digital switches
Level 2	Nodal/Local	approximately 40 digital switches
Level 1	Satellite	approximately 109 switches

The interconnection of switches on the fiber optic network will use 2 Mbps E-1 channels and the rest of the network will be interconnected through existing carrier channels and systems. The total number of railway users of the new digital telephone network will be approximately 26,000. The percentage of users with access to digital data and video services will be around 10%.

A new numbering plan will be introduced with the new switch network to insure those supplementary services and to accommodate non-railway users. The telephone call number will be formed as follows:

a) Local Number 4 digits
b) Interurban Prefix 3 digits

The numbering plan will include dedicated digits for the automatic and semi-automatic interurban access, exit to public network, and special services.

The digital network will use SS#7 signaling according to ITU recommendations, which is adopted by UIC for interconnection with neighboring railway administrations.

The digital switches will be synchronized using a signal from the digital transmission network. Switches not on the fiber optic network will be synchronized using PCM contact connections.

The main objectives of the switching network management are picking, transmitting, selecting, processing, and keeping data concerning:

- Quality of operation;
- Network configuration;
- Arrangements and alarms;
- Traffic;
- Users;
- Customer billing; and
- Monitoring for diagnostic purposes.

The tender document for this equipment has not been completed and will likely not be published before February 1999. The number of switches to purchase under this tender is still under consideration.

IRIS Data Network

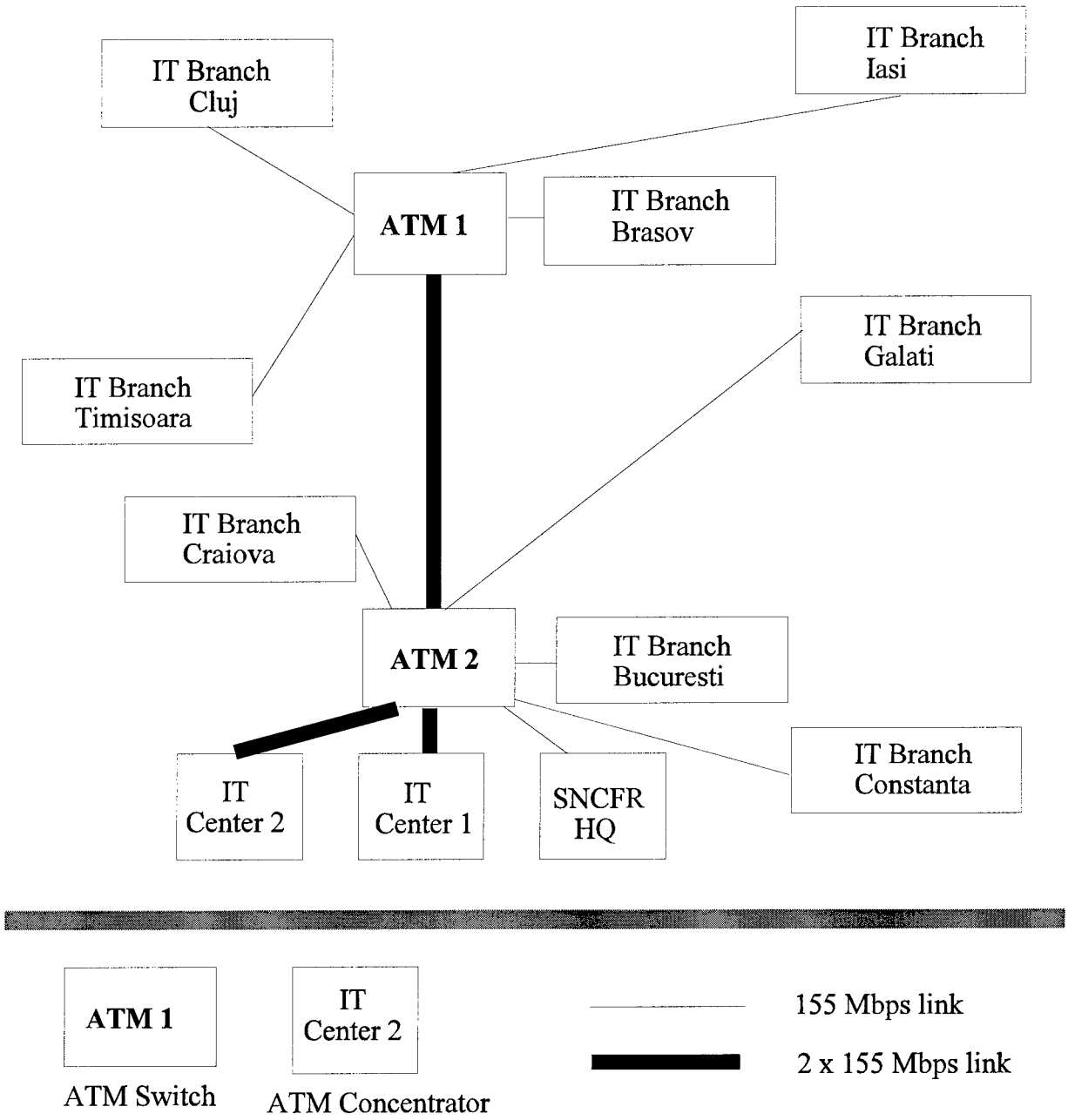
SNCFR is revamping its Management Information System under the acronym IRIS (Integrated Railway Information System). The IRIS program will offer assistance both for operative and tactical management levels and for company strategic planning. The highest priority IRIS applications are for financial accounting and control and for assets management. Priority applications have been identified in sales and marketing (passenger ticketing and reservation system, freight tariff management system); operations (fuel consumption, train control and wagon control systems); maintenance (rolling stock and infrastructure maintenance systems) and human resources. IRIS implementation cannot go forward without the digital transmission system first being implemented. The existing X.25 packet switching network will be integrated into the digital transmission system within the project implementation time frame. The existing X.25 network will be integrated into the new IRIS data network when development reaches that stage.

As shown in Figure 2-1, the new digital data network for IRIS consists of two parts as follows:

(1) Two Asynchronous Transfer Mode (ATM) switches will be installed: one in Bucharest and the other in Brasov. There will be two STM-1 speed (155.52 Mbps) links between Bucharest and Brasov. Also, there will be two local 155.52 Mbps circuits between the ATM site in Bucharest and the two IT centers in Bucharest (IT Center 1 and IT Center 2).

(2) The ATM switch in Brasov will be connected to four IT Branches (Brasov, Iasi, Cluj, and Timisoara), which are four of the eight SNCFR Regional Headquarters. The connection between the ATM Brasov and each of these four IT branch locations will be provided by one 155.52 Mbps link. In a similar fashion, the ATM switch in Bucharest will be connected to the SNCFR Regional Headquarters in Galati, Bucharest, Constanta, and Craiova. At each of the SNCFR Regional Headquarters an ATM concentrator will be installed, from which circuits will connect to various SNCFR facilities. An additional 155.52 Mbps link will be established between the ATM switch in Bucharest and the ATM concentrator of SNCFR Administrative Headquarters in Bucharest.

Figure 2-1: ATM Data Transmission Backbone



In summary, the IRIS data network will contain fifteen 155.52 Mbps links between ATMs; 105 data circuits of 2 Mbps; 312 data circuits of 64 Kbps; 107 X.25 circuits; and 33 modem circuits of 14.4 Kbps. The IRIS passenger ticketing application will require about 279 data circuits with an average length of 10 km. The system will contain approximately 2,200 workstations with 60% for data entry and 40% for query. Some 60% of the workstations will have printers to print tickets.

Most of the IRIS data network will be on the new fiber optic transmission system so that the network is expected to operate efficiently with a very low error rate.

Broadband Video Communications

A digital TV transmission system (video-codec) will work over the SDH transmission network of SNCFR. This system provides high quality transmission using a relatively low bit rate. It will be suitable for the following applications:

- Railway system supervisory (monitoring) networks where full-motion pictures are transmitted over long distances;
- Railway video conferencing;
- Links between TV transmitters and studios;
- Links between the TV center and satellite earth stations; and
- TV distribution networks.

The TV transmission system will allow high quality transmission of composite color video signals, component video signals, and digital studio standard signals.

The video-codec will operate at a relatively low transmission bit rate of 34 Mbps.

C. POTENTIAL SYSTEM IMPROVEMENTS

The telecommunications system upgrades, financed through the World Bank credit and the Government of Romania, will give SNCFR a top-of-the-line digital

transmission and switching network. However, there are a few more areas of SNCFR's network that need to be considered to improve the Railway's train movements. The most important of these is dispatcher-to-train radio and replacement of worn out radios. More fiber optic transmission systems need to be installed to close loops and additional old analog switches need to be replaced.

Dispatcher-to-Train Radio

After the digital transmission system is fully activated, sufficient channels will be available to connect the dispatcher offices with the appropriate radio base stations. This can be done with dedicated channels or a party line to a few base stations equipped with selective ringing. An existing cleared frequency or a new frequency needs to be assigned for this application. This frequency should be low enough so that all track areas are "seen" from the base stations. A frequency band of 0.7 meter could be used for this application. The frequency is 454.600 - 458.100 MHz and 467.600 - 468.100 MHz. This should include branch line train operations as well. SNCFR is expected to receive GSM TR 25-09 radios under the EIRENE Project (European Integrated Radio Enhanced Network). The EIRENE system can be used for the Dispatcher Station-to-Train application as well if it comes soon enough. The use of EIRENE would allow voice and data communications with trains. The GSM-R cellular radio will enable speech and data to be exchanged with trains operating anywhere in Europe. However, a new frequency has been assigned to GSM radios for Railway operations. This frequency is 876-880 MHz and 921-925 MHz.

Radio Replacement

SNCFR has a total of approximately 13,000 radios with 10,810 in the Infrastructure Department and 2,190 in the Traction Department. The Infrastructure Department needs to replace 3,353 fixed radio stations, 732 mobile radios, and 5,225 portable radios for a total of 9,310 radios. The Traction Department has 2,040 radios for locomotives, 50 fixed station radios and 100 portable radios, most of which need replacing.

Additional Fiber Optic Transmission Facilities

There are additional locations on SNCFR's right-of-way where fiber optic rings could be completed. These include the areas between Timisoara and Filiasi; Pitesti

and Sibiu; Buzau and Faurei; and Adjud and Beclean pe Somes. Also another heavy traffic branch line between Cluj-Napoca and Oradea could be built as a branch or continued down to Arad to form another fiber ring. These additional fiber optic systems would then be equipped with SDH transmission equipment and connected to the existing SDH transmission system. (Recommended ring extensions are analyzed in further detail in Section 5, Part B).

Additional Digital Switching Systems

There will be about 27 old Basa and crossbar telephone switches in operation after the World Bank digital switch upgrade is completed. These should be replaced with digital switches. This would make the network all digital, except for some electronic satellite switches.

Operation and Maintenance Control

Operation of the telecommunications network needs to be controlled from headquarters in Bucharest. Each selected district would have a head communications supervisor who would report directly to central headquarters in Bucharest. This supervisor would have control of all telecommunications operation and maintenance personnel in his district. The supervisor would be responsible to implement requests by local users for district telecommunications applications. The supervisor would attend periodic meetings in Bucharest for an update on system telecommunications improvements and problem solving techniques.

Wavelength Division Multiplexing

A great deal of research is going on with optical fibers. Optical fiber producing companies are trying to optimize the number of systems that can be carried on a single fiber pair. They are shifting the dispersion of the fiber away from the 1528 to 1565 nm (nanometer) window resulting in a positive (+) 3ps/nm-km or a negative (-) 3ps/nm-km of dispersion. The dispersion curve must not pass through zero (0) within the above 1528 to 1565 nm window. In this window eight 10-gigabit OC 192 sonet systems (the U.S. counterpart to STM-64 switches) can be installed with WDM (Wavelength Division Multiplexing).

Wireless Local Loop

Underground local access loops take the longest time to deploy and are the largest portion of infrastructure costs. In Romania, due to lower labor costs, they cost less to install than in most European locations. Generally, a shift from wire lines to wireless models is possible at low cost. This change can be effected in a short time and will have lower operating and maintenance costs. Wireless Local Loops (WLL) can be used in rural, suburban, and urban environments. Wireless access technology is used within a selected spectrum allocation to the service capability of the selected system. CDMA (Code Division Multiple Access) is secure by design since a PN code is used to spread the signal over a wider spectrum. Wireless loop equipment is sold by a number of companies today and the cost of a local loop runs about $400-700 per subscriber.

Broadband ISDN Systems and Video

Broadband Integrated Services Digital Network (B-ISDN) is a set of services, capabilities, and interfaces supporting an integrated network and user interface at speeds greater than ISDN. The ITU-T initially decided to develop B-ISDN using ATM in 1988. B-ISDN would need to use fiber optic lines and ATMs to deliver services with data transmission rates of more than 150 Mbps. This technology is still being developed.

D. PROJECTED INTERNAL TELECOMMUNICATIONS NEEDS

SNCFR telecommunications will change significantly from the technology it is using today. It will use new digital technology for a large portion of its system by the year 2000. The system will have in operation a completed World Bank project. Fiber optic cable will have been installed on 3,600 km of main line railway. The fiber optic cable will contain twenty fibers with approximately ten fibers assigned to the Railway applications and the other fibers assigned to the external market. A powerful SDH (Synchronous Digital Hierarchy) transmission system using the 2.48 Gbps STM-16 and the lower speeds of STM-4 and STM-1 will have been installed and operational. The new digital switching network will be in operation replacing a large portion of the existing switching network. At this time, it appears the digital switches to be installed will be as follows:

Quantity	Switch use
1	International
8	Regional/Transit
40	Local
109	Satellite (Digital, Electronic & Basa)

The Railway's internal switch capacity will require an assignment of approximately 33,200 subscriber lines from the year 2001 through 2008. A graph showing this capacity and a projected peak hour demand for the internal railway system is shown in Figure 2-2.

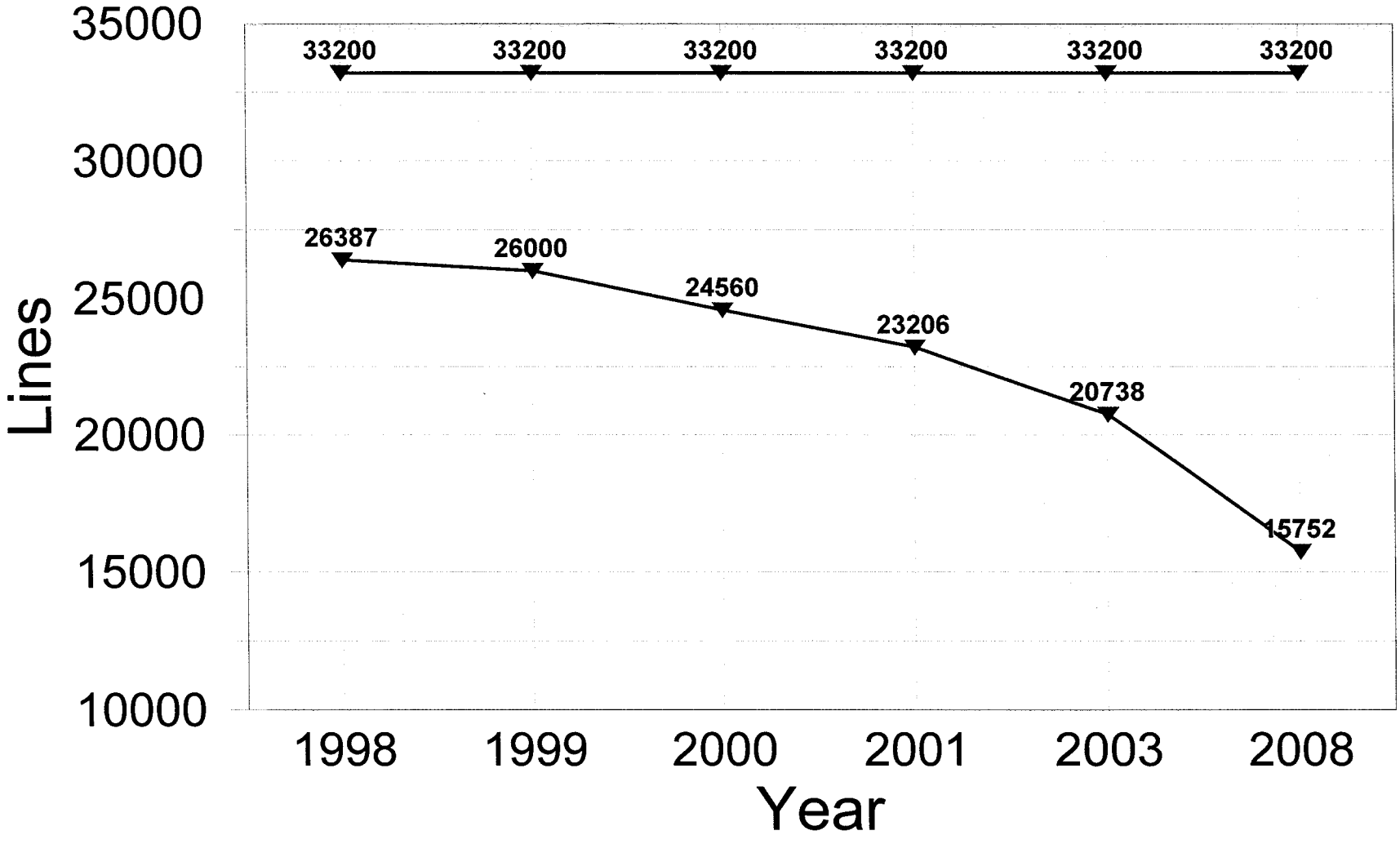
The red line on Figure 2-2 shows the total capacity set aside for the Railway's switch applications. The blue line represents the predicted peak hour demand. It is assumed that with privatization and modernization, SNCFR will undergo a period of gradual reduction in its workforce in order to become a "leaner", more efficient organization. Hence, beginning in the year 2000, an annual reduction of 6% is projected. In 1999, the number of Railway subscribers is estimated to be approximately 26,000. This includes 2,000 subscribers who are not officially a part of SNCFR, but are important railway shippers and suppliers who presently utilize the Railway's telecommunications system.

The peak hour capacity utilization for SNCFR's internal telecommunications can be computed from Figure 2-2 by dividing the peak hour demand by the total capacity. The capacity utilization is 79.5% in 1998, 78.3% in 1999, and 73.9% in 2000 and is expected to reach its lowest level (47.4%) in 2008, and will remain at this level thereafter. Therefore, additional capacity will become available which may shift some of the telecommunications assets dedicated for the Railway's use to commercial applications.

In addition to the configuration for the internal system, a number of projects will need to be funded and completed by the year 2008. A dispatcher- to-train radio system needs to be provided as soon as possible before the year 2003. It is urgently needed at this time. Also a large number of radios need replacing.

Additional fiber optic transmission facilities need to be installed at numerous locations on main lines and some branch lines where fiber optic rings could not be completed. Also some 27 old telephone switches need to be replaced with digital switches. This would provide an all-digital switching system. A large number of

Figure 2-2: Total Capacity vs. Peak Hour Demand (Internal)



radios and old telephone switches will be retired as a result of the change out of this equipment.

Table 2-1 presents in a summary format the internal telecommunications system needs for the base year 1998 and the projected configuration for 2000, 2003, and 2008.

Table 2-1: Internal System Needs

ITEM	1998	2000	2003	2008
International Switches (Digital)	0	1	1	1
Transit Switches (Digital)	0	8	8	8
Local Switches	88	40	40	40
Satellite Switches	88	109	109	109
Total Switches	176	158	158	158
Satellite Basa Switches	included	27	27	-
Satellite Crossbar Switches	included	-	-	-
Total Equipped Line Capacity	33,200	33,200	33,200	33,200
Subscriber Lines (Internal)	26,387	24,560	20,738	15,752
Busy Hour Traffic (Erlangs)	4,590	11,700	10,800	10,800
Erlangs per Subscriber	0.174	0.450	0.450	0.450
Total Trunks	6,181	11,331	10,814	10,814
Average Network Capacity Utilization (%)	80	74	63	47
Digital Subscribers (Internal)	0	2,600	20,738	15,752
Analog Subscribers (Internal)	26,387	21,960	0	0

SECTION 3:
MARKET ISSUES -
EXTERNAL TELECOMMUNICATIONS MARKET

A. EXISTING TELECOMMUNICATIONS MARKET

Overview

The existing external telecommunications market is largely defined by the current subscribers of Rom Telecom. This comprises approximately 3.1 million subscribers according to the latest Government statistics (1996) and has been growing at the rate of approximately 150,000 to 200,000 subscribers per year. The 1996 distribution of these subscribers by counties in Romania and telephone penetration rates are shown in Table 3-1. Current data from the Rom Telecom monopoly is not publicly available but forecasts would indicate that the 1998 subscriber population should be about 3.45 million lines for a penetration rate of 15.4%.

To this data must be added GSM (cellular telephone providers) and VSAT (satellite) data services. The current GSM operations are reported to be at a level of about 400,000 subscribers. The railway itself also handles approximately 2,000 billable subscribers (railway suppliers and customers) over its existing system. Complete information on other private data system providers is not available. Despite this lack of data, the size of the existing telecommunications market remains largely defined by the Rom Telecom monopoly.

Status of Existing Telecom Installations and Service

Rom Telecom's national infrastructure is dominated by old analog technology in all parts of its network. Modernization began in 1991, shortly after the 1989 Revolution, with a digital overlay network (DON), the major part of which has been completed. The DON consists of 7,000 km of fiber optic cables equipped with SDH and PDH transmission systems. The fiber optic system links eight digital transit exchanges and 1.4 million subscribers who are connected to digital switches. The digitalization so far achieved in the overall network is approximately 40% in switching and 50% in transmission. But these improvements so far have had little impact on improving the quality of service for the overburdened system.

Table 3-1: Telephone Subscribers by County and Telephone Penetration Rate as of December 31, 1996

COUNTY	No. OF SUBSCRIBERS	POPULATION	% URBAN	PENETRATION RATE
Alba	45265	403494	57.6	11.2
Arad	74607	477711	52.1	15.6
Arges	81776	677246	47.6	12.1
Bacau	107076	745463	50.5	14.4
Bihor	81405	628501	49.6	13.0
Bistrita-Nasaud	33465	327262	37.0	10.2
Botosani	38462	461793	40.1	8.3
Brasov	96595	637463	76.2	15.2
Braila	46862	389881	66.6	12.0
Buzau	55734	510718	41.4	10.9
Caras-Severin	42113	362498	56.8	11.6
Calarasi	27289	334164	39.7	8.2
Cluj	113580	726790	68.8	15.6
Constanta	119182	747122	73.6	16.0
Covasna	28098	231872	52.7	12.1
Dambovita	51394	555410	31.5	9.3
Dolj	92505	751938	51.1	12.3
Galati	79802	641561	60.3	12.4
Giurgiu	25280	300615	30.7	8.4
Gorj	32168	396990	42.7	8.1
Harghita	32785	344323	46.0	9.5
Hunedoara	59300	543848	76.1	10.9
Ialomita	28730	304985	41.6	9.4
Iasi	100055	822573	50.9	12.2
Maramures	61883	535124	53.3	11.6
Mehedinti	29964	327521	48.7	9.1
Mures	92490	604263	51.8	15.3
Neamt	58964	584780	40.9	10.1
Olt	38196	517597	39.9	7.4
Prahova	139372	868099	52.4	16.1
Satu Mare	47605	394133	46.4	12.1
Salaj	30647	261040	41.9	11.7
Sibiu	85267	444873	68.5	19.2
Suceava	62625	710845	35.8	8.8
Teleorman	34336	470280	34.4	7.3
Timis	104958	692645	62.0	15.2
Tulcea	27180	266897	49.0	10.2
Vaslui	35390	462703	43.7	7.6
Valcea	39606	435274	40.7	9.1
Vrancea	36157	392571	38.7	9.2
Mun. Bucuresti	701775	2037278	100.0	34.4
Total/Average	**3119943**	**22330144**	**54.9**	**14.0**

Source: Comisia Nationala pentru Statistica (National Commission for Statistics),***Anuarul Statistic al Romaniei 1997*** (Romanian Statistical Yearbook 1997) on 1.4 Mb diskette,Bucharest, Romania.

Switching capacity for public exchange service has 3.6 million lines and comprises:

- 10% Rotary 7A and 7D designed 70 years ago and in service for as long as 55 years.
- 41% Crossbar Pentaconta designed more than 40 years ago and last manufactured in Romania in 1993. Equipment has been in service for 20 years.
- 9% manually operated switches.
- 40% digital switching provided by joint ventures with Siemens and Alcatel.

Toll switching equipment is largely analog, electro-mechanical and manual, with only eight digital toll switching units. International communications are switched through one automatic digital transit switch and one semi-automatic Pentaconta switch. Incoming calls are served automatically to the end subscriber. Outgoing calls are served automatically for those connected to digital switches, and through operators for the balance of subscribers. The ratio of international incoming calls to outgoing calls is about 1.3:1. International traffic is carried on the INTELSAT system through two Standard A earth stations; on one EUTELSAT earth station; and on terrestrial routes in neighboring countries.

The long distance network comprises 100,000 trunks. Digital transmission is based upon PDH-140 Mbps and SDH STM-4 technology. With the exception of low capacity 34 Mbps digital microwave links, the remaining long distance network consists of analog systems such as microwave links operating in the 2, 4, 6, 7 and 8 Ghz bands, and coaxial cables with capacities of 960, 1800 and 2700 channels.

The microwave links are more than 20 years old. They are operated and maintained by Rom Radiocom, which leases the 960 or 1800 channel circuit capacities to Rom Telecom.

The local access network comprises aerial transport cables strung on poles or buildings between the distribution frame of the local switch and the subscriber.

The most common transport cables consist of paper insulated, copper conductors installed in protective ducts. There are over 380,000 km of cable in ducts included in the system. Most of these cables are at least 30 years old and in poor condition due to failure of the insulation.

Drop wires for connection to subscribers are 0.9 mm galvanized steel wire, locally manufactured and insulated with PVC.

Modern wireless technologies were introduced in 1996 on a pilot basis. The initial wireless pilot projects were:

- Sibiu and Brasov - Orbitel cordless telephone using the 864-868 MHz band.
- Snagov and Iasi - Ericsson Digital European Cordless Telephone (DECT) using the 1880-1900 MHz band (there is a Ministry of Defense concern in Snagov regarding EMC compatability with their own uses in this band).
- Arad - CDMA equipment from Orlanda (Netherlands) using the 3640 to 3740 and 3850 to 3950 MHz bands.

Since that time, at least two joint service providers have emerged in the major cities and licensing is becoming increasingly easy.

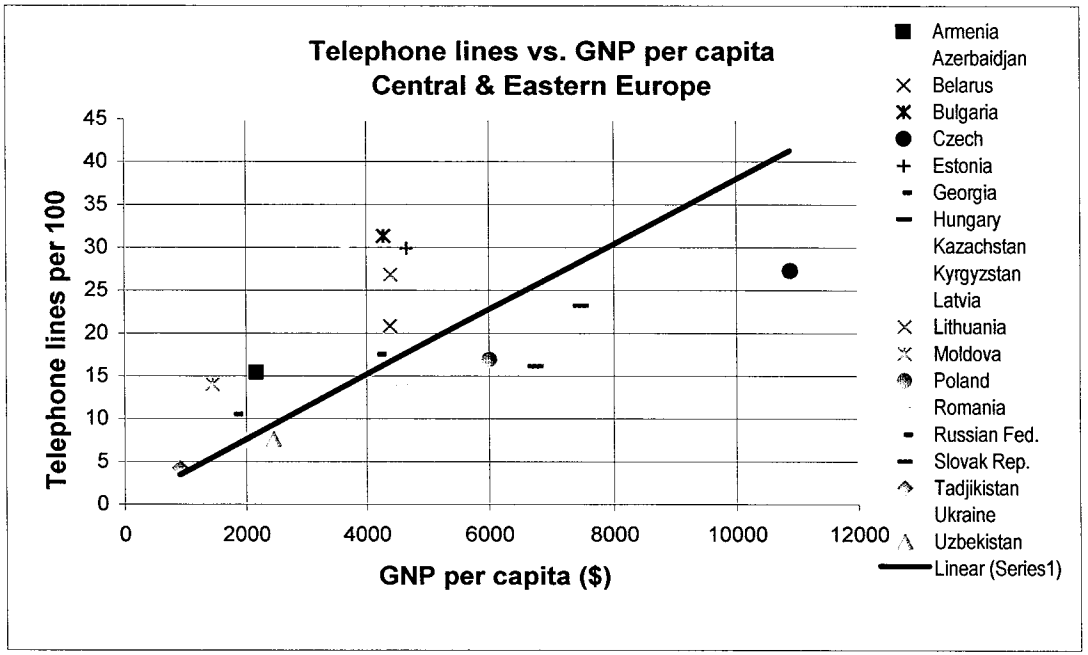
As stated earlier, access to telephone service and the penetration rate for telephone service is poor. Romania's 1996 penetration rate was only 14%, second lowest in its immediate region and growing very slowly (Figure 3-1). By contrast, penetration rates in other Central European countries range from 14% (Moldova) to 31% (Bulgaria)[3]. The situation has been addressed by Government policy setting a 30% goal by the year 2003 and is further motivated by EU guidelines to achieve a 30% penetration rate.

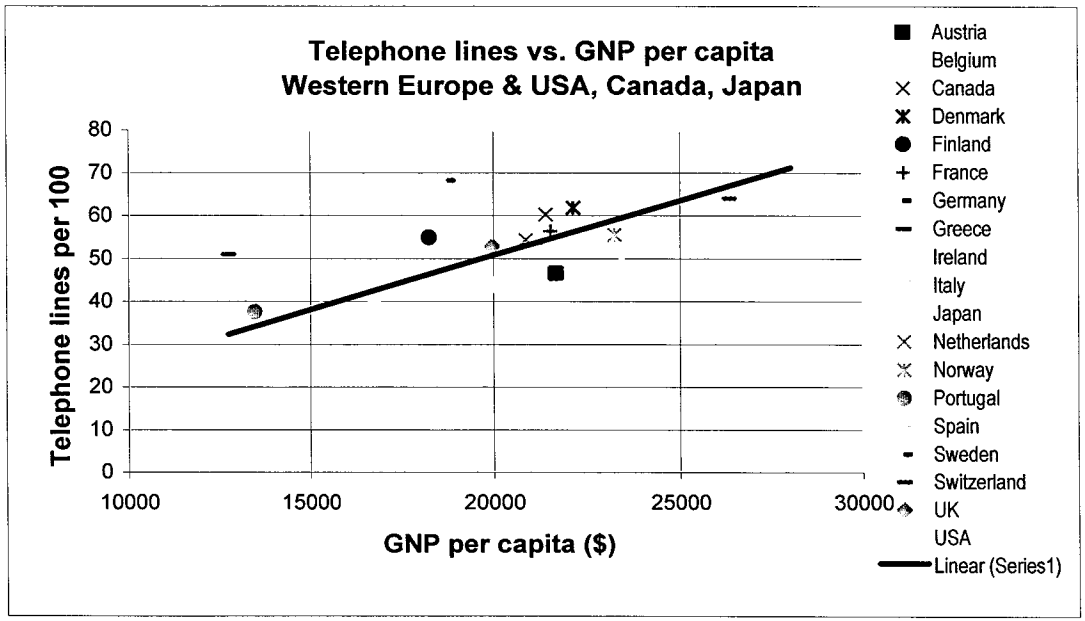
[3] The Bulgarian telephone subscriber data is overstated because of the widespread use of party lines with two subscribers per line. For comparison purposes, the penetration rate of 31% for Bulgaria should be halved.

Figure 3-1: Per Capita GNP and Teledensity, 1996

Country	GNP per capita	Teledensity
Armenia	2160	15.4
Azerbaidjan	1490	8.5
Belarus	4380	20.8
Bulgaria	4280	31.3
Czech	10870	27.3
Estonia	4660	29.9
Georgia	1810	10.5
Hungary	6730	16.1
Kazachstan	3230	11.8
Kyrgyzstan	1970	7.5
Latvia	3650	29.8
Lithuania	4390	26.8
Moldova	1440	14
Poland	6000	16.9
Romania	4580	14
Russian Fed.	4190	17.5
Slovak Rep.	7460	23.2
Tadjikistan	900	4.2
Ukraine	2230	18.1
Uzbekistan	2450	7.6

Country	GNP per capita	Teledensity
Austria	21650	46.6
Belgium	22390	46.5
Canada	21380	60.2
Denmark	22120	61.8
Finland	18260	54.9
France	21510	56.4
Germany	21110	53.8
Greece	12730	50.9
Ireland	16750	39.5
Italy	19890	44
Japan	23420	48.9
Netherlands	20850	54.3
Norway	23220	55.5
Portugal	13450	37.5
Spain	15290	39.2
Sweden	18770	68.2
Switzerland	26340	64
UK	19960	52.8
USA	28020	64





Source: ***World Bank Atlas, 1998***

While the penetration rate reaches as high as 70% in central Bucharest, the metropolitan area as a whole achieves only one-half that amount, and the telephone service penetration drops very quickly as one moves into the country. While there are 9,800 localities with telephone service in Romania, only 380 have direct-dial long distance service. Furthermore, there are nearly 2,000 rural communities which have no telephone service at all. The queue of potential subscribers requesting service numbers 1.3 million entries. Some potential subscribers must wait as long as four years before receiving a connection.

The rural situation may be partially explained by Romania's largely agricultural economy. But overall, the underdeveloped telephone situation presents opportunities for development of additional telecommunications services in support of Romania's move into a free market economy.

Residential lines comprise the majority of the subscribers. Business lines comprise only 12% of the connections but account for the major source of revenues. Some 22% of the total lines are in Bucharest itself leaving 78% spread throughout the rest of the country. The new digital switches installed in major cities such as Bucharest, Brasov, Galati, and Cluj are mainly used for business subscribers.

Basic telephone service (local, long distance, and international) is Rom Telecom's principal business. To date, Rom Telecom is the only provider of local access lines. In addition, Rom Telecom provides other services including:

- Telex services with fully automatic access to most countries of the world (8,000 subscribers)

- Private network and packet switched services, some in joint venture with other providers, such as:
  - France Telecom (Global One)
  - DIGICOM
  - Logic Telecom (established by US Sprint)

- Cellular services in joint ventures with others, such as:
  - Telefonica (Spain) and Rom Radiocom
  - France Telecom
  - Telesystem Wireless of Canada and Airtouch of USA

Rom Telecom's quality of service is judged to be one of the poorest in the region. The system's average call completion rate is approximately 50% as compared to international norms of 70%. The problem is attributed to congestion in the network resulting from insufficient capacity in the switching and transmission facilities. The fault rate is reported to be 1.2 faults per line per year as compared to a norm of 0.2. However, Rom Telecom's response time to clear faults of 74% in 24 hours and 85% in 48 hours compares favorably with industry norms.

Desired Market Size and Environment

The Government of Romania has set a goal of 30% market penetration by the year 2003 for telecommunications services. This goal is said to match with EU requirements for Romania's entry into that economic community. As shown in Figure 3-1, the lowest penetration in the EU is 37.5% in Portugal. Achievement of a 30% penetration rate would assist in supporting Romania's development of a more technologically advanced economy and wider participation in the free market world.

The 30% penetration goal by 2003 also matches the December 31, 2002 date set by the Government for the end of Rom Telecom's monopoly of basic telephone services. Considering the task to be achieved, there can be considerable doubt that such a goal can indeed be reached, especially in a time frame of five years.

Achievement of the 30% goal requires an installation rate of 500,000 lines (net) per year. Rom Telecom's past installation rate has been a maximum of 200,000 lines per year. Successful accomplishment requires doubling the system size to a forecast 6.8 million lines in 2003. The installation task is estimated to require $7 billion, at an average cost of $2000 per subscriber, before considering maintenance and replacement of existing obsolete or deteriorated facilities, which is estimated to cost an additional $5 - 7 billion.

Another underlying problem is likely to be encountered in Rom Telecom's traditional organization undertaking the accomplishment of a task double or triple its normal output over the short period of five years. Rom Telecom is a very large, Government-managed organization. As such, it will be prone to inflexible bureaucratic processes and politically motivated decision making. These are poor organizational characteristics to have in place for a job that faces tremendous change and requires quick, "on-the-ground" decision-making with substantial monetary support.

The Government has partially overcome the problem by opening the market to specialty providers. This is most obviously seen in the proliferation of cellular telephones. The cellular telephones circumvent the huge task of installing 3.4 million additional access lines in the local loops. But they also fail to solve the problem of substantially extending basic telephone service. Only a select segment of the populace can afford the charges for such service.

It appears as if the real solution for more extensive telephone service will have to wait until the year 2003 when additional providers and competitive access are allowed into the market place. The Government's invitation to find an early partner in 1998 for the progressive privatization of Rom Telecom will help. But the sheer size of the project, and the internal obsolescence and organization changes to be overcome, cast doubt on the possibility of reaching a 30% penetration rate by 2003. SNCFR's modernization fits into this schedule.

B. MARKET SIZE AND GROWTH POTENTIAL

A statistical review of Romania's situation and comparisons to other economies of the world are appropriate to assess Romania's goal for more extensive telephone services. Rom Telecom's statistics are private and not available. However, the data from the Romanian National Commission for Statistics and the World Bank can help present the picture. In the following tables and graphs, Romania's situation in population, urbanization, telephone subscribers, and adjusted Gross National Product (GNP) will be presented.

Urbanization

A beginning approach to predict telephone installation is to look at urbanization of the Romanian population. Installation of telephone access lines is more prevalent in urban areas. One would expect a higher business demand and less costly stringing of the access cables and drops.

Table 3-2 and Figures 3-2, 3-3, and 3-4 illustrate Romania's trend toward urbanization (and possibly increased telephone service). Table 3-2 indicates that urbanization has been increasing between the years 1980 and 1997, the last year for which figures are available. Urbanization has increased from 45.8% to 55%.

But the graphs plotted from this data show that the trend is not uniform. There is a hump or a break in the trend in 1990. As shown in Figure 3-2, a single trend line can be fit to the data with a good R^2 value (92.6% of the variation in urbanization explained by the year of occurrence). This trend would indicate a percent urbanization of 59.7% by 2003 and 62.4% by 2008. But the years since 1990 seem to indicate that the urbanization trend has abated. Therefore, a single trend line fit for 1980-1997 data (as shown in Figure 3-2) does not satisfactorily represent the reality since 1990.

A polynomial curve was fit to the urbanization data with an excellent R^2 value of 0.9817 (Figure 3-3). This describes the past trend very well but forecasts a declining urban population, which is not sensible in light of long-term trends, both Romanian and worldwide.

Lastly, the data was separated into pre-revolution and post-revolution periods, and separate linear trends were fit to the separated data (Figure 3-4). These lines exhibit good fits to the historical data (R^2 = 0.979 and 0.951). They describe a difference in urbanization between a forced industrial economy favoring establishment of large manufacturing facilities at or near cities and an early evolution of a free market economy. Based on its ability to better represent reality, the linear projection of 56% urbanization in 2003 and 56.8% in 2008 will be used to further develop an external telephone market forecast later in this Section.

Population

Another indicator of telephone service demand is likely to be population. Therefore, data was extracted from Government statistics to consider the trends from 1980 through 1997. This data is shown in Table 3-3 and is plotted at the bottom of the table. The data shows an even stronger difference between the pre-revolutionary and post-revolutionary periods. The data indicates a sharp post-revolution exodus from Romania as the disrupted economy slowed and jobs became unavailable. The 1991 data is understood to be a projection of the past by the Government without correcting the estimated population to reflect this trend. The first post-revolution census in 1992 establishes a definite loss of population. The pre-revolution trend exhibits an upward trend under the Government's command economy and with forbidden abortion. The post revolution trend shows a population loss of about 49,000 persons per year which may be attributed to out-migration due to a weak economy and the adoption of family planning.

Table 3-2: Mid-Year Urban and Rural Population Distribution in Romania

YEAR	%URBAN	%RURAL
1980	45.8	54.2
1981	46.9	53.1
1982	48.4	51.6
1983	49	51
1984	49.2	50.8
1985	50	50
1986	50.6	49.4
1987	51.3	48.7
1988	51.9	48.1
1989	53.2	46.8
1990	54.3	45.7
1991	54.1	45.9
1992	54.3	45.7
1993	54.5	45.5
1994	54.7	45.3
1995	54.9	45.1
1996	54.9	45.1
1997	55	45

Source: 1980-1996 data from Comisia Nationala pentru Statistica

Figure 3-2: Urbanization Trend - Linear Regression

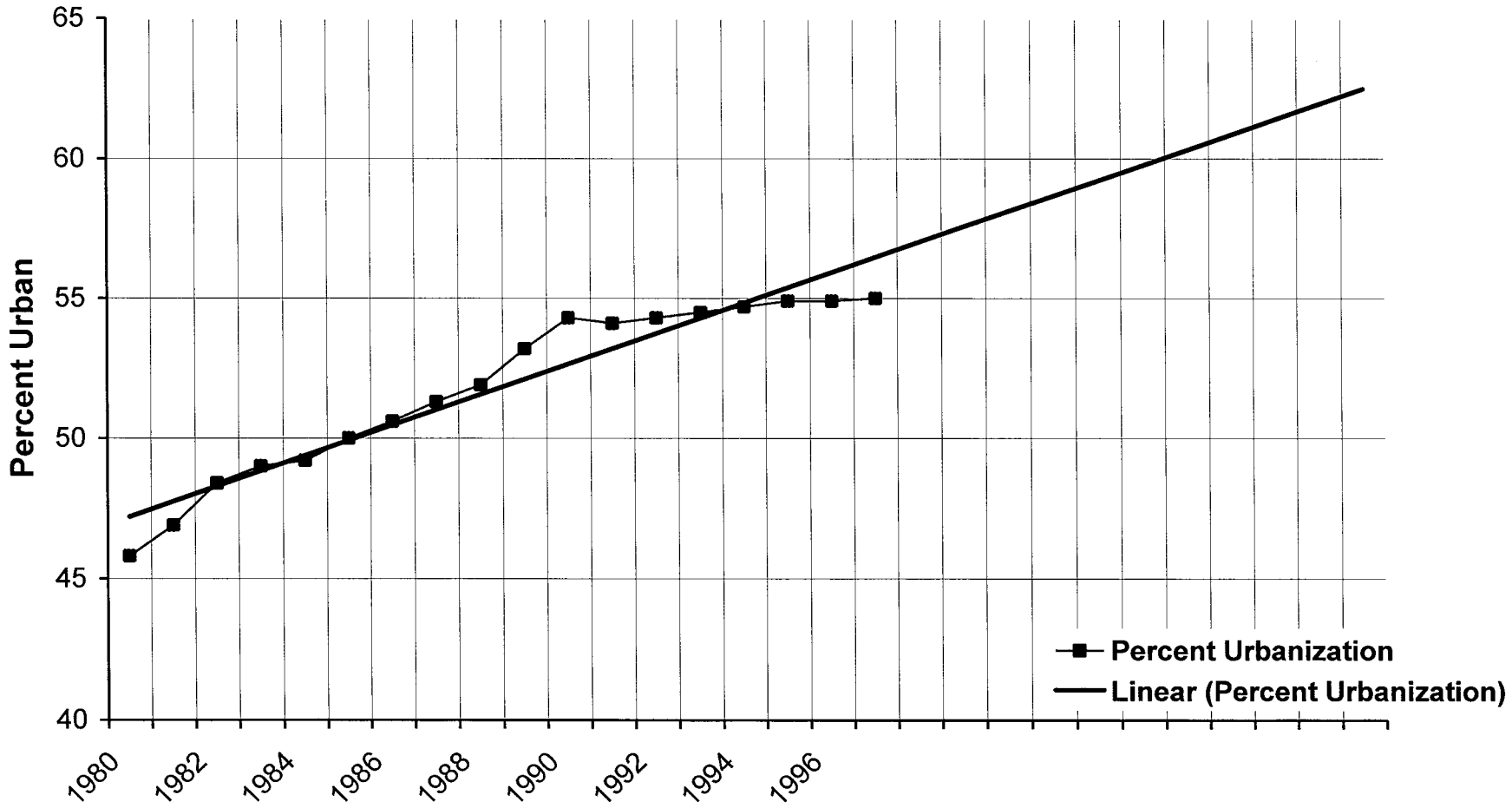


Figure 3-3: Urbanization Trend - Polynomial Regression

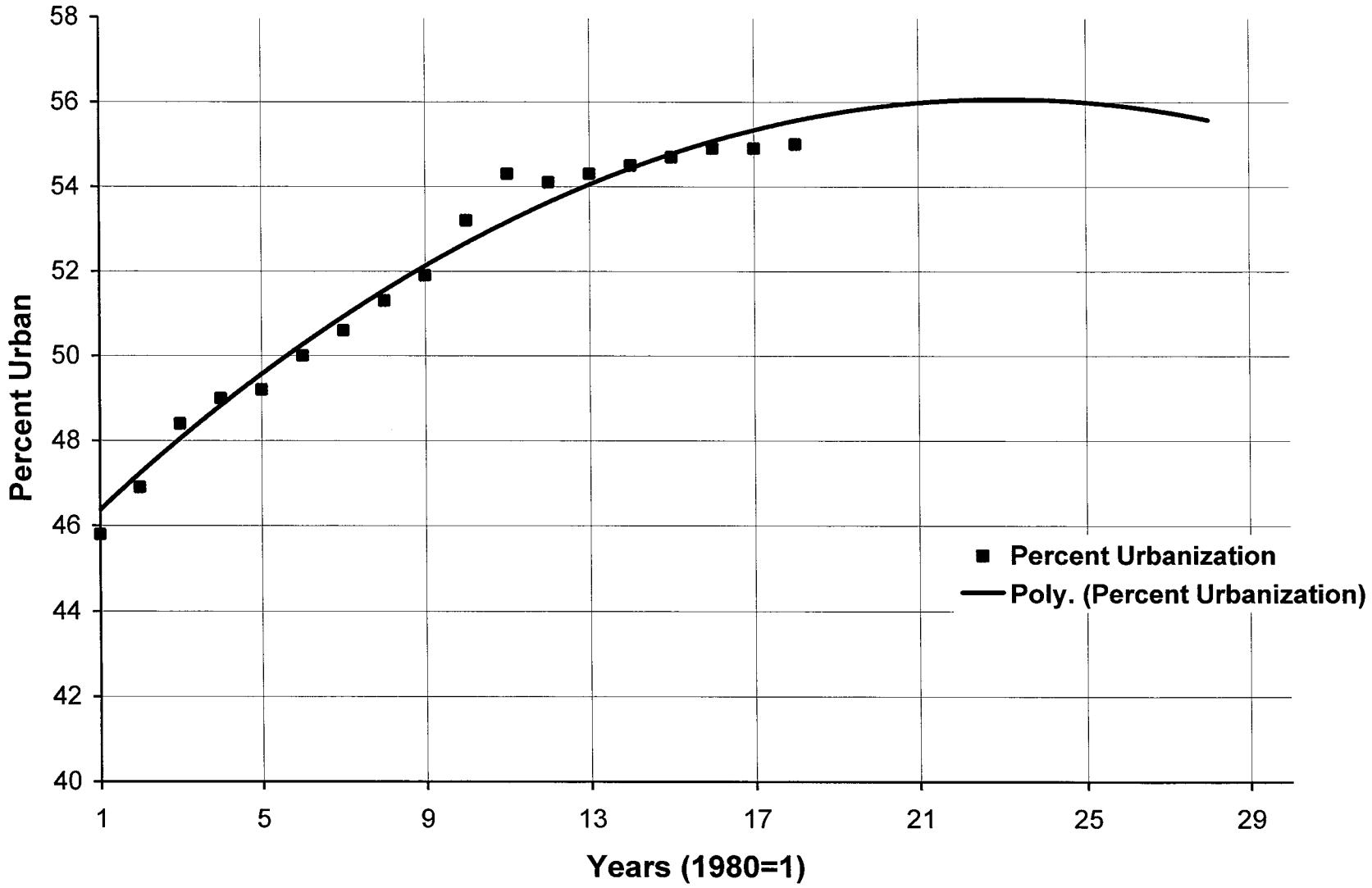


Figure 3-4: Urbanization Trend - Separate Linear Regressions

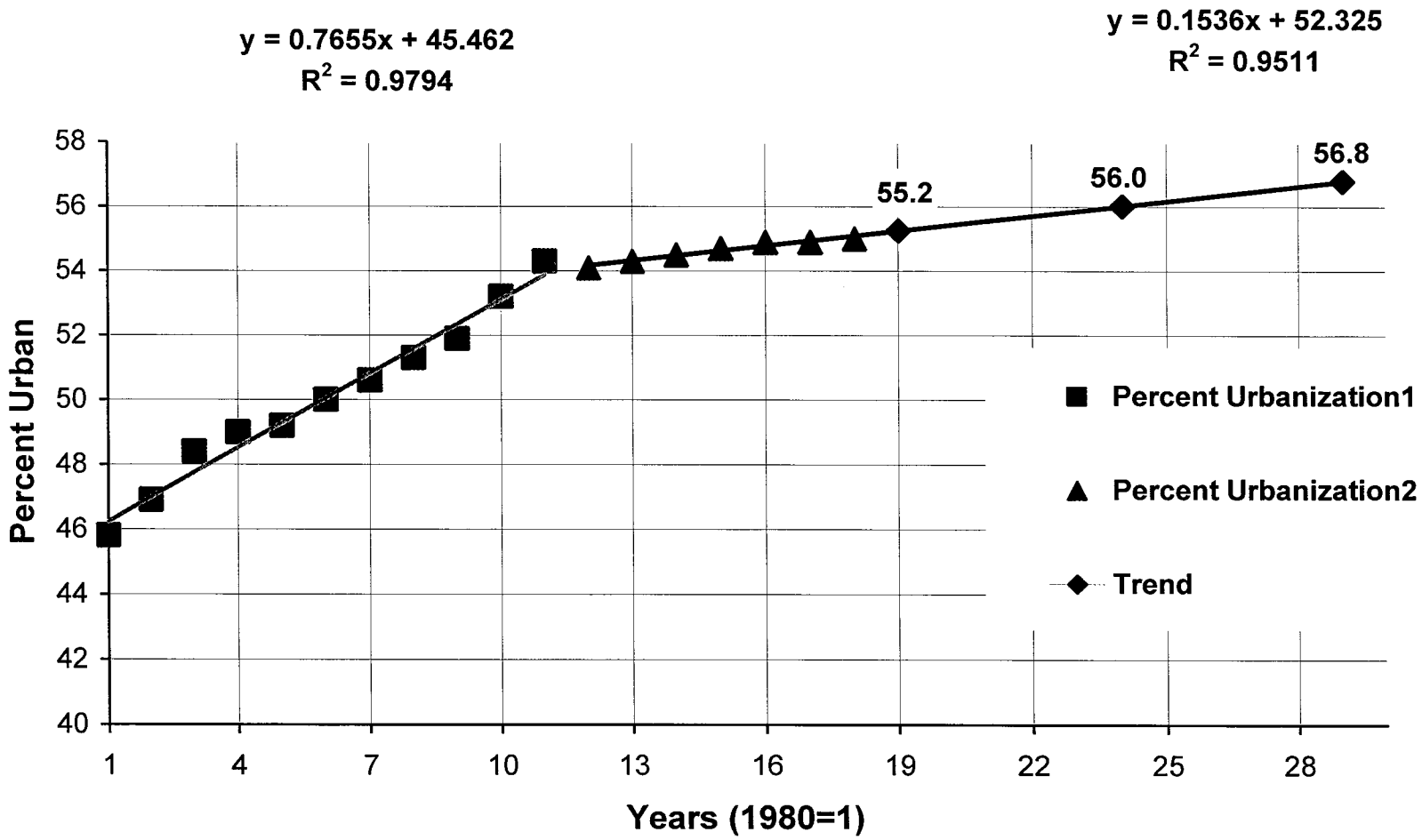


TABLE 3-3: Total Population Mid-year 1980-1997

YEAR	POPULATION
1980	22201387
1981	22352635
1982	22477703
1983	22553074
1984	22624505
1985	22724836
1986	22823479
1987	22940430
1988	23053552
1989	23151564
1990	23206720
1991	23185084
1992	22788969
1993	22755260
1994	22730622
1995	22680951
1996	22607620
1997	22545925

Source:1980-1995 data from ***Anuarul Statistic al Romaniei 1996*** (Romanian Statistical Yearbook) 1996-1997 data from ***Buletin Statistic Trimestrial 4/1997*** (Quarterly Statistical Bulletin 4/1997); Bucharest, Romania.

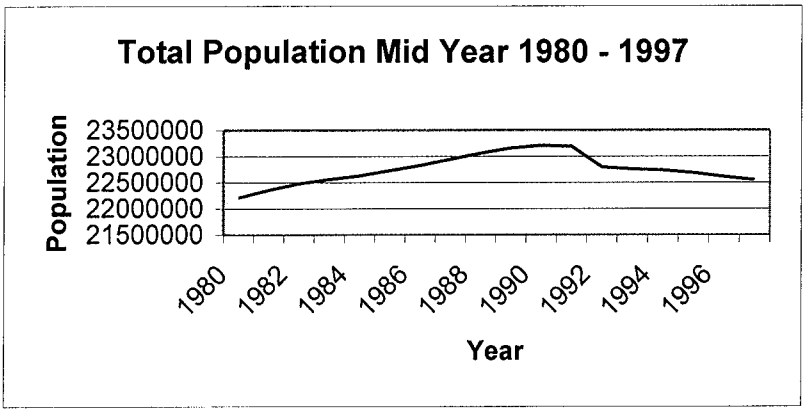


Figure 3-5 shows the situation more clearly with linear regression lines for both periods. If one were to use the post-revolution regression to forecast the next ten years, there would be a continuing loss of population and a somewhat smaller demand for telephone service. But assuming the Romanian economy rebounds and once again becomes a growing economy, informed opinion is that the population curve will follow the return to an upward trend similar to the Polish and Czech Republic experiences whose economies have preceded Romania in moving from command to market economies. Therefore, a similar 0.4% annual growth rate, starting in 2001, has been used to forecast population for the years 2003 and 2008.

County Level Telephone Subscribers

We now take the 1996 population and percent urban data by county and add the total telephone subscribers by county and calculate the penetration rate for each county. Table 3-4 illustrates this information. The 1996 penetration rates vary from 7.3% in Teleorman County to an average of 34.4% in urban Bucharest (70% in the city core). The average penetration rate for the nation in 1996 was 14%. Using both the percent urban trend and the general population trend calculated above, we can now make a multiple regression of this data to forecast telephone subscribers in 1998, 2003, or 2008, if no changes are made to the existing investment in and management of Romania's basic telecommunications system and service.

A multiple logorithmic regression was run of the county-based 1996 subscribers against population and percent urban data. The equation which gave the best statistical fit with an R^2 value of 0.887 is in the form of:

$S_{ij} = (12705.55)\ (1.000001677^{Pij})\ (1.011537443^{Uij})$, where
S_{ij} = Total number of subscribers in county (i) in year (j);
P_{ij} = Population of county (i) in year (j); and
U_{ij} = Percent urban population in county (i) in year (j).

As shown in Table 3-5, the calculation indicates that only 3.502 million Rom Telecom lines would be installed by 2003, well short of the desired 6.8 million telephones required for a 30% penetration rate.

The forecast data can be adjusted by increasing the installation rate to 500,000 (net) new lines per year over the five years to 2003, which rate will yield the desired 30% penetration rate for telephone service. This exercise for 2003 and

Figure 3-5: Population Trends

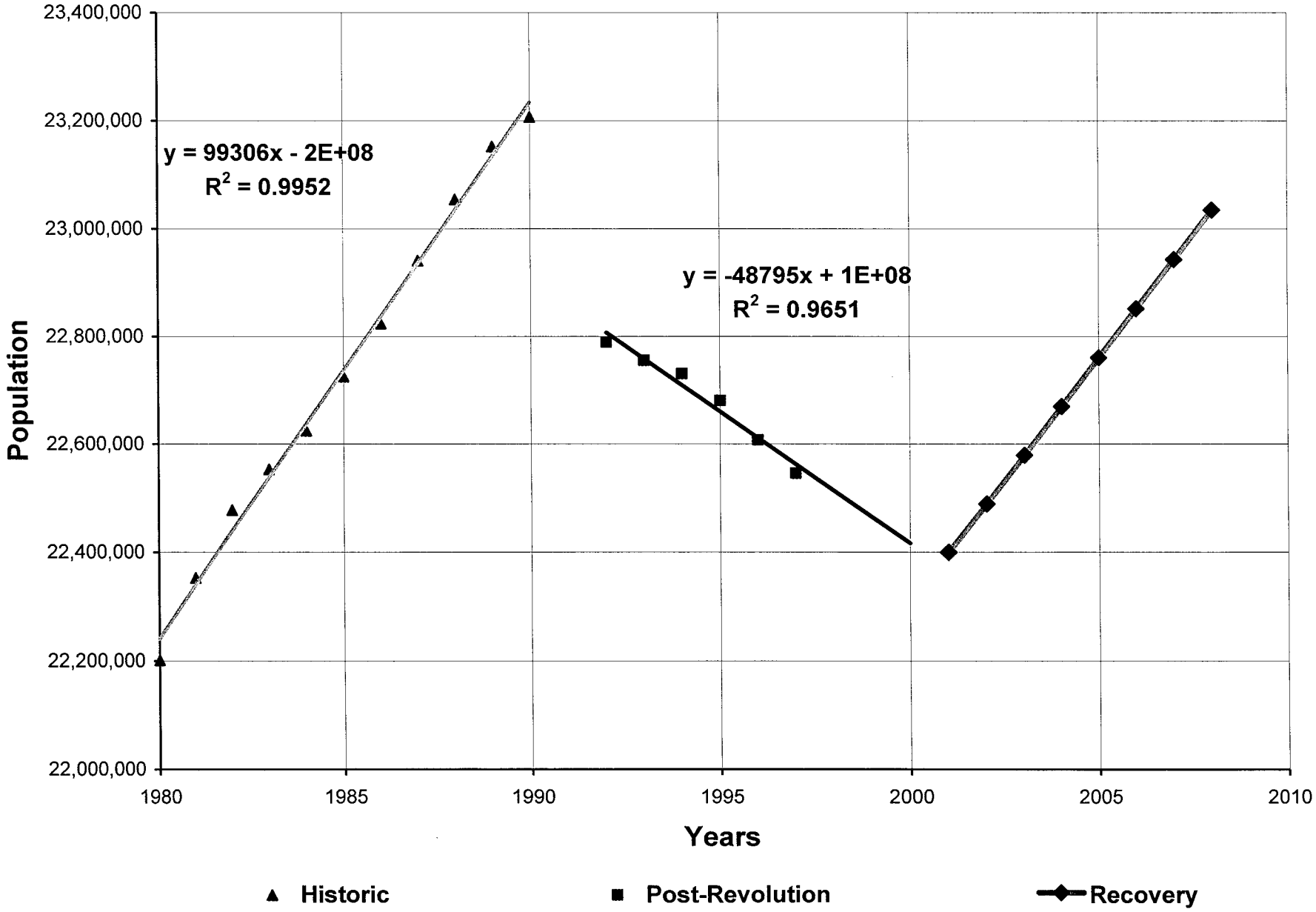


Table 3-4: Telephone Subscribers by County and Telephone Penetration Rate as of December 31, 1996

COUNTY	No. OF SUBSCRIBERS	POPULATION	% URBAN	PENETRATION RATE
Alba	45265	403494	57.6	11.2
Arad	74607	477711	52.1	15.6
Arges	81776	677246	47.6	12.1
Bacau	107076	745463	50.5	14.4
Bihor	81405	628501	49.6	13.0
Bistrita-Nasaud	33465	327262	37.0	10.2
Botosani	38462	461793	40.1	8.3
Brasov	96595	637463	76.2	15.2
Braila	46862	389881	66.6	12.0
Buzau	55734	510718	41.4	10.9
Caras-Severin	42113	362498	56.8	11.6
Calarasi	27289	334164	39.7	8.2
Cluj	113580	726790	68.8	15.6
Constanta	119182	747122	73.6	16.0
Covasna	28098	231872	52.7	12.1
Dambovita	51394	555410	31.5	9.3
Dolj	92505	751938	51.1	12.3
Galati	79802	641561	60.3	12.4
Giurgiu	25280	300615	30.7	8.4
Gorj	32168	396990	42.7	8.1
Harghita	32785	344323	46.0	9.5
Hunedoara	59300	543848	76.1	10.9
Ialomita	28730	304985	41.6	9.4
Iasi	100055	822573	50.9	12.2
Maramures	61883	535124	53.3	11.6
Mehedinti	29964	327521	48.7	9.1
Mures	92490	604263	51.8	15.3
Neamt	58964	584780	40.9	10.1
Olt	38196	517597	39.9	7.4
Prahova	139372	868099	52.4	16.1
Satu Mare	47605	394133	46.4	12.1
Salaj	30647	261040	41.9	11.7
Sibiu	85267	444873	68.5	19.2
Suceava	62625	710845	35.8	8.8
Teleorman	34336	470280	34.4	7.3
Timis	104958	692645	62.0	15.2
Tulcea	27180	266897	49.0	10.2
Vaslui	35390	462703	43.7	7.6
Valcea	39606	435274	40.7	9.1
Vrancea	36157	392571	38.7	9.2
Mun. Bucuresti	701775	2037278	100.0	34.4
Total	**3119943**	**22330144**	**2089.3**	**14.0**

Source: Comisia Nationala pentru Statistica (National Commission for Statistics), ***Anuarul Statistic al Romaniei 1997*** (Romanian Statistical Yearbook 1997) on 1.4 Mb diskette, Bucharest, Romania.

TABLE 3-5 County Level Subscriber Projections, 1998, 2003, and 2008

COUNTY	Total Population (1996)	% Urban (1996)	% Rural (1996)	Percent Population Share (1996)	1998 Population	2003 Population	2008 Population	1996 Urban Index	1998 Percent urban	2003 Percent urban	2008 Percent urban	Est. 1998 Subscribers Logarithmic	Est. 2003 Subscribers Logarithmic	Est. 2008 Subscribers Logarithmic	1998 Penetration Rate	2003 Penetration Rate	2008 Penetration Rate	Adjusted 2003 Subscribers	Adjusted 2008 Subscribers	2003 Adjusted Penetration Rate	2008 Adjusted Penetration Rate
Alba	403494	57.6	42.4	1.78%	401522	402985	411110	1.049	57.9	58.8	59.6	48412	49001	50154	12.06%	12.16%	12.20%	115349	124000	28.62%	30.16%
Arad	477711	52.1	47.9	2.11%	475377	477109	486728	0.949	52.4	53.1	53.9	51427	52028	53337	10.82%	10.90%	10.96%	122475	131661	25.67%	27.05%
Arges	677246	47.6	52.4	3.00%	673937	676392	690029	0.867	47.9	48.6	49.2	68119	68946	71105	10.11%	10.19%	10.30%	162301	174473	24.00%	25.28%
Bacau	745463	50.5	49.5	3.30%	741821	744523	759533	0.920	50.8	51.5	52.2	78928	79959	82693	10.64%	10.74%	10.89%	188226	202342	25.28%	26.64%
Bihor	628501	49.6	50.4	2.78%	625430	627709	640364	0.903	49.9	50.6	51.3	64262	65046	66994	10.27%	10.36%	10.46%	153118	164602	24.39%	25.70%
Bistrita-Nasaud	327262	37.0	63.0	1.45%	325663	326849	333439	0.674	37.2	37.7	38.3	33614	33890	34479	10.32%	10.37%	10.34%	79777	85760	24.41%	25.72%
Botosani	461793	40.1	59.9	2.04%	459537	461211	470509	0.730	40.3	40.9	41.5	43606	44023	45015	9.49%	9.55%	9.57%	103631	111403	22.47%	23.68%
Brasov	637463	76.2	23.8	2.82%	634348	636660	649495	1.388	76.6	77.7	78.8	88654	90139	93281	13.98%	14.16%	14.36%	212189	228103	33.33%	35.12%
Braila	389881	66.6	33.4	1.72%	387976	389390	397240	1.213	67.0	67.9	68.9	52502	53215	54524	13.53%	13.67%	13.73%	125270	134665	32.17%	33.90%
Buzau	510718	41.4	58.6	2.26%	508223	510074	520358	0.754	41.6	42.2	42.8	48031	48515	49701	9.45%	9.51%	9.55%	114204	122770	22.39%	23.59%
Caras-Severin	362498	56.8	43.2	1.60%	360727	362041	369340	1.035	57.1	57.9	58.8	44796	45323	46319	12.42%	12.52%	12.54%	106691	114693	29.47%	31.05%
Calarasi	334164	39.7	60.3	1.48%	332531	333743	340471	0.723	39.9	40.5	41.1	35079	35384	36024	10.55%	10.60%	10.58%	83295	89542	24.96%	26.30%
Cluj	726790	68.8	31.2	3.21%	723239	725874	740508	1.253	69.2	70.2	71.2	94486	96002	99526	13.06%	13.23%	13.44%	225992	242941	31.13%	32.81%
Constanta	747122	73.6	26.4	3.30%	743471	746180	761224	1.341	74.0	75.1	76.1	103311	105066	109085	13.90%	14.08%	14.33%	247329	265878	33.15%	34.93%
Covasna	231872	52.7	47.3	1.03%	230739	231580	236249	0.960	53.0	53.8	54.5	34358	34711	35293	14.89%	14.99%	14.94%	81710	87838	35.28%	37.18%
Dambovita	555410	31.5	68.5	2.46%	552696	554710	565893	0.574	31.7	32.1	32.6	46166	46566	47698	8.35%	8.39%	8.43%	109618	117839	19.76%	20.82%
Dolj	751938	51.1	48.9	3.33%	748264	750990	766131	0.931	51.4	52.1	52.9	80340	81401	84210	10.74%	10.84%	10.99%	191619	205990	25.52%	26.89%
Galati	641561	60.3	39.7	2.84%	638426	640752	653670	1.098	60.6	61.5	62.4	74305	75352	77782	11.64%	11.76%	11.90%	177379	190683	27.68%	29.17%
Giurgiu	300615	30.7	69.3	1.33%	299146	300236	306289	0.559	30.9	31.3	31.8	29898	30107	30571	9.99%	10.03%	9.98%	70873	76188	23.61%	24.87%
Gorj	396990	42.7	57.3	1.76%	395050	396490	404483	0.778	42.9	43.6	44.2	40328	40715	41560	10.21%	10.27%	10.27%	95844	103032	24.17%	25.47%
Harghita	344323	46.0	54.0	1.52%	342641	343889	350822	0.838	46.3	46.9	47	38368	38745	39500	11.20%	11.27%	11.26%	91206	98047	26.52%	27.95%
Hunedoara	543848	76.1	23.9	2.41%	541191	543162	554113	1.386	76.5	77.6	78.7	75744	76968	79398	14.00%	14.17%	14.33%	181184	194772	33.36%	35.15%
Ialomita	304985	41.6	58.4	1.35%	303495	304601	310741	0.758	41.8	42.4	43.0	34152	34454	35054	11.25%	11.31%	11.28%	81105	87188	26.63%	28.06%
Iasi	822573	50.9	49.1	3.64%	818554	821536	838099	0.927	51.2	51.9	52.7	90183	91409	94787	11.02%	11.13%	11.31%	215179	231318	26.19%	27.60%
Ilfov	277476	7.0	93.0	1.23%	276120	277126	282713	0.128	7.0	7.1	7.2	21886	21948	22181	7.93%	7.92%	7.85%	51667	55542	18.64%	19.65%
Maramures	535124	53.3	46.7	2.37%	532509	534449	545224	0.971	53.6	54.4	55.1	57387	58090	59678	10.78%	10.87%	10.95%	136744	147000	25.59%	26.96%
Mehedinti	327521	48.7	51.3	1.45%	325921	327108	333703	0.887	49.0	49.7	50.4	38487	38879	39632	11.81%	11.89%	11.88%	91522	98386	27.98%	29.48%
Mures	604263	51.8	48.2	2.67%	601311	603501	615668	0.944	52.1	52.8	53.6	63301	64087	65976	10.53%	10.62%	10.72%	150861	162176	25.00%	26.34%
Neamt	584780	40.9	59.1	2.59%	581923	584043	595818	0.745	41.1	41.7	42.3	54037	54601	56072	9.29%	9.35%	9.41%	128533	138173	22.01%	23.19%
Olt	517597	39.9	60.1	2.29%	515068	516945	527366	0.727	40.1	40.7	41.3	47752	48223	49402	9.27%	9.33%	9.37%	113518	122032	21.96%	23.14%
Prahova	868099	52.4	47.6	3.84%	863857	867005	884484	0.954	52.7	53.4	54.2	98999	100399	104295	11.46%	11.58%	11.79%	236341	254066	27.26%	28.72%
Satu Mare	394133	46.4	53.6	1.74%	392207	393636	401572	0.845	46.7	47.3	48.0	41886	42313	43214	10.68%	10.75%	10.76%	99607	107077	25.30%	26.66%
Salaj	261040	41.9	58.1	1.15%	259765	260711	265967	0.763	42.1	42.7	43.4	31847	32122	32634	12.26%	12.32%	12.27%	75615	81286	29.00%	30.56%
Sibiu	444873	68.5	31.5	1.97%	442699	444312	453270	1.248	68.9	69.9	70.9	58823	59661	61262	13.29%	13.43%	13.52%	140444	150977	31.61%	33.31%
Suceava	710845	35.8	64.2	3.14%	707372	709949	724262	0.652	36.0	36.5	37.0	62880	63531	65465	8.89%	8.95%	9.04%	149553	160770	21.07%	22.20%
Teleorman	470280	34.4	65.6	2.08%	467982	469687	479156	0.627	34.6	35.1	35.6	41414	41772	42685	8.85%	8.89%	8.91%	98332	105707	20.94%	22.06%
Timis	692645	62.0	38.0	3.06%	689261	691772	705718	1.129	62.3	63.2	64.1	82520	83732	86606	11.97%	12.10%	12.27%	197106	211889	28.49%	30.02%
Tulcea	266897	49.0	51.0	1.18%	265593	266561	271935	0.893	49.3	50.0	50.7	34904	35248	35860	13.14%	13.22%	13.19%	82976	89199	31.13%	32.80%
Vaslui	462703	43.7	56.3	2.05%	460442	462120	471436	0.796	43.9	44.6	45.2	45524	45987	47054	9.89%	9.95%	9.98%	108254	116373	23.43%	24.68%
Valcea	435247	40.7	59.3	1.93%	433120	434698	443462	0.741	40.9	41.5	42.1	42006	42405	43327	9.70%	9.76%	9.77%	99822	107309	22.96%	24.20%
Vrancea	392571	38.7	61.3	1.74%	390653	392076	399981	0.705	38.9	39.5	40.0	38227	38567	39335	9.79%	9.84%	9.83%	90787	97596	23.16%	24.40%
Mun. Bucuresti	2037278	100.0	0.0	9.01%	2027324	2034710	2075731	1.821	100.0	100.0	100	1198705	1213646	1300074	59.13%	59.65%	62.63%	1404000	1509300	69.00%	72.71%
Total	**22607593**	**2045.8**	**2103.7**	**100.00%**	**22497130**	**22579097**	**23034304**	**54.900**	**55.2**	**56**	**56.8**	**3459653**	**3502174**	**3652839**	**15.38%**	**15.51%**	**15.86%**	**6791244**	**7300587**	**30.08%**	**31.69%**

2008 is shown in the last four columns of Table 3-5. Column by column study of Table 3-5 indicates the huge task to be undertaken by the Rom Telecom monopoly to reach the penetration goal of 30% by 2003.

Penetration Rate and Per Capita GNP

The last set of statistics to be presented are those related to telephone subscribers per 100 inhabitants (penetration rate) vs. gross national product (GNP). In Figure 3-1 earlier in this section (page 51), Romania is compared in relationship to various areas of the world. This information is not presented as a forecast but as a check on the reasonableness of the telephone penetration goals.

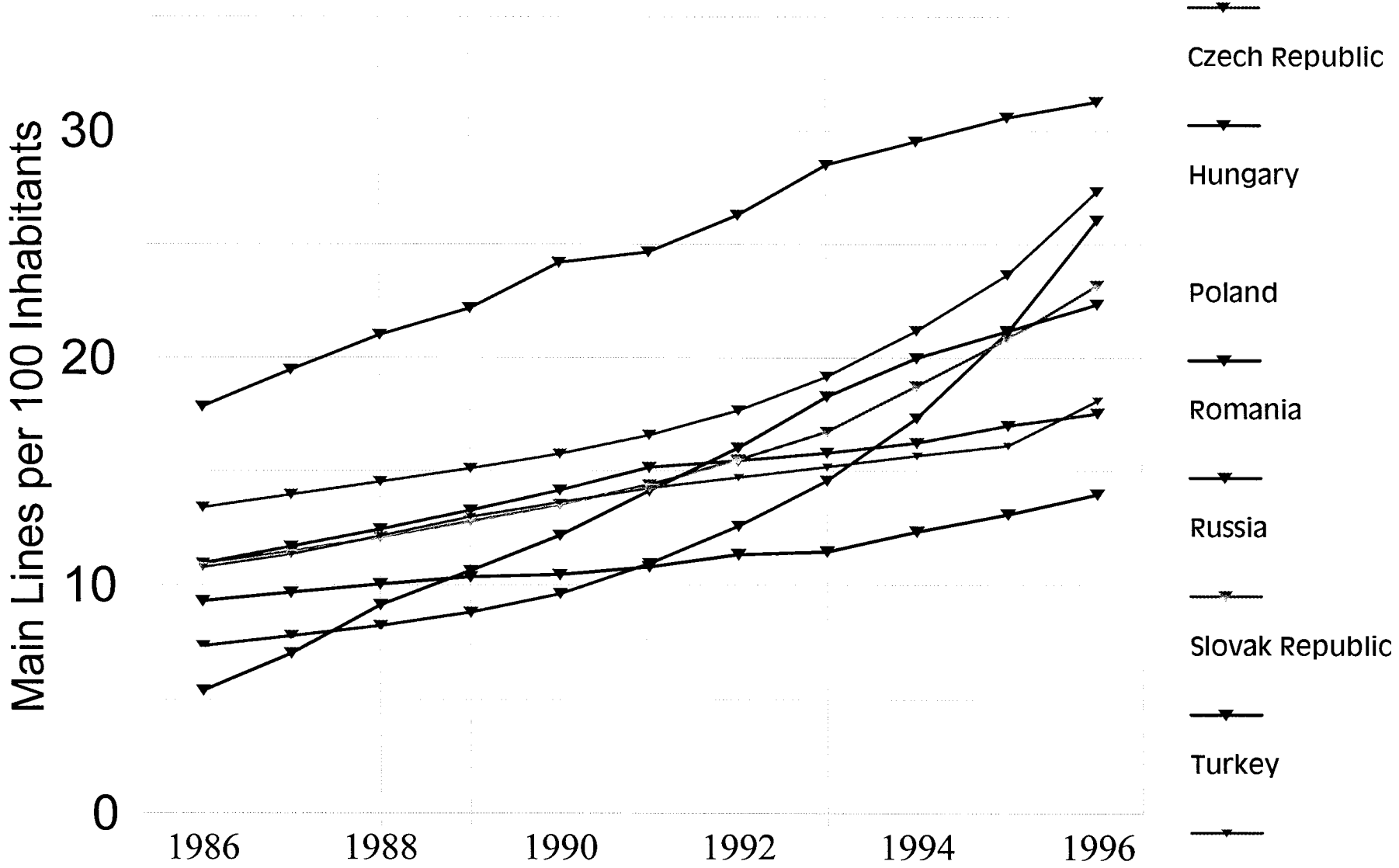
The information is first presented as a table accompanied by two small charts, telephone lines vs. GNP/capita. The data is divided into two sets: (1) Central and Eastern Europe; and (2) Western Europe and selected economically advanced countries.

What Figure 3-1 clearly points out is that among these families of nations, Romania's telephone subscribers per 100 inhabitants is very near the norm. One might conclude that given Romania's level of economic development, the telephone penetration rate is about equal to what the nation (populace) can sustain. Romania's GNP is about one-fifth of the trailing edge of the developed Western European countries, and to reach a penetration rate of 30% would imply that the GNP/capita should increase threefold over the next five years, an unlikely result.

On the other hand, reading the graph vertically, one sees that all Romania's neighbors, except Georgia, exceed Romania's penetration rate. The information leads one to conclude that Romania, with proper management and policy, can increase her telephone penetration rate above the trend line, but that a 30% penetration rate for basic telephone services may have to await further development of Romania's economy. Early liberalization of the Romanian telephone industry may help in achieving that goal.

Figure 3-6 illustrates the impact that telecommunications privatization can have on teledensity rates. The dramatic rise of the rates of teledensity for Hungary and the Czech Republic coincide with these countries' move toward privatization of their telecommunications sectors in 1993. Whereas a country such as Romania, which had not begun this process, shows only slight growth in its teledensity rate. For

Figure 3-6: Teledensity of Selected Countries 1986 - 1996



Source: International Telecommunication Union, 1997 Yearbook of Statistics, Geneva,

Romania to achieve a high teledensity growth rate and reach 30% by 2003, it appears that it would be necessary to complete the privatization process in 1998. When the growth trends shown in Figure 3-6 are compared against the worldwide teledensity timetable in Figure 1-1 (see page 16), Romania can increase teledensity from 20% to 30% at best within three years, but only with privatization.

Traffic and Revenues

Traffic and revenue data are difficult to obtain. This information is generally privately held and guarded. However, it is possible to ascertain some idea of volumes and size by accessing ITU (International Telecommunication Union) historical data and World Bank Reports.

Rom Telecom telecommunications traffic in 1994, the last complete year of reporting, totaled 547 million minutes divided as shown in Table 3-6.

It is difficult to ascertain the volume of traffic generated in the years following 1994, but partial data for 1995 and 1996 implies an imbalanced growth between business lines and residential lines. There is a similar dissimilarity between national trunk line minutes and international trunk line minutes. There is a strong, but relatively smaller, growth in the business sector call volume, but the residential sector call volume appears to be almost stagnant. If one then looks at the call minutes volume, there is a strong growth in international call minutes, but the national trunk call minutes are unchanged or even decreasing. Tables 3-7, 3-8, and 3-9 illustrate the call frequency and call minute relationships. There is insufficient data for the fourth value, national trunk line call minutes, but they are reported to be 305 million minutes in 1995 and were not increasing from the two previous years.

Table 3-6: Rom Telecom Telephone Traffic - 1994

Type	Traffic Minutes (Million)
National Trunk Lines	300
International outgoing calls	72
International incoming calls	175
Total Telephone Traffic	547

Table 3-7: National trunkline telephone (calls)

Year	Number (millions)
1986	96
1987	98
1988	98
1989	97
1990	80
1991	89
1992	87
1993	86
1994	75
1995	77

Source: International Telecommunications Union 1997 Statistics

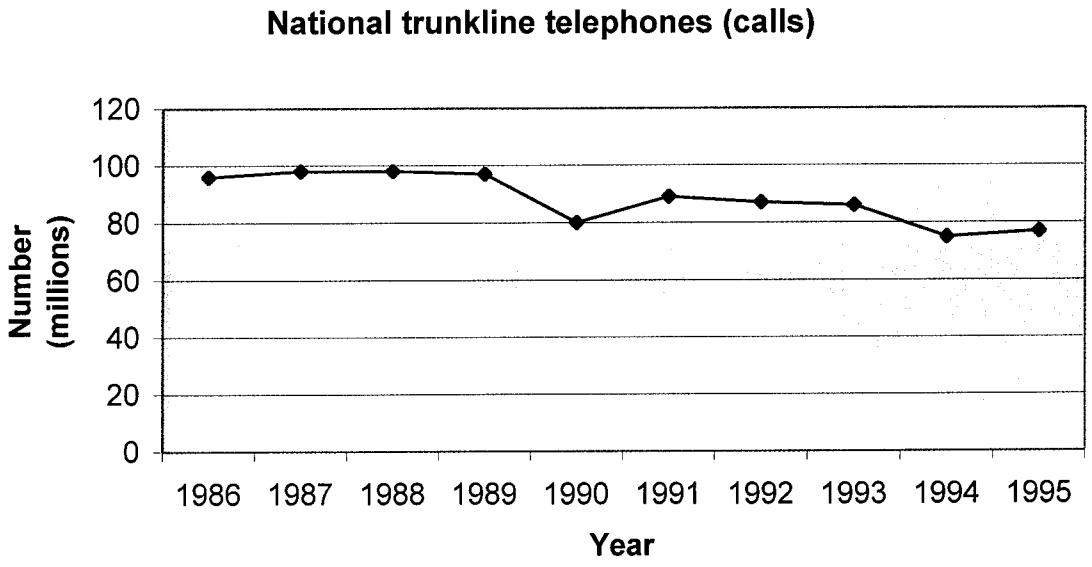


Table 3-8: International outgoing telephone (calls)

Year	No. (millions)
1986	0.9
1987	1.0
1988	1.2
1989	1.3
1990	2.2
1991	4.6
1992	10.5
1993	14.2
1994	19.7
1995	22.6

Source: International Telecommunications Union 1997 Statistics

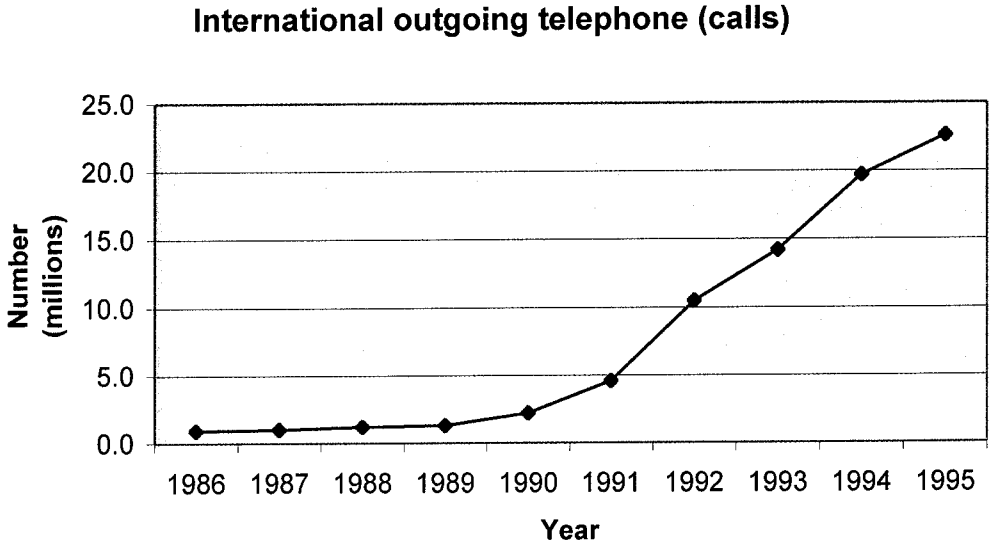
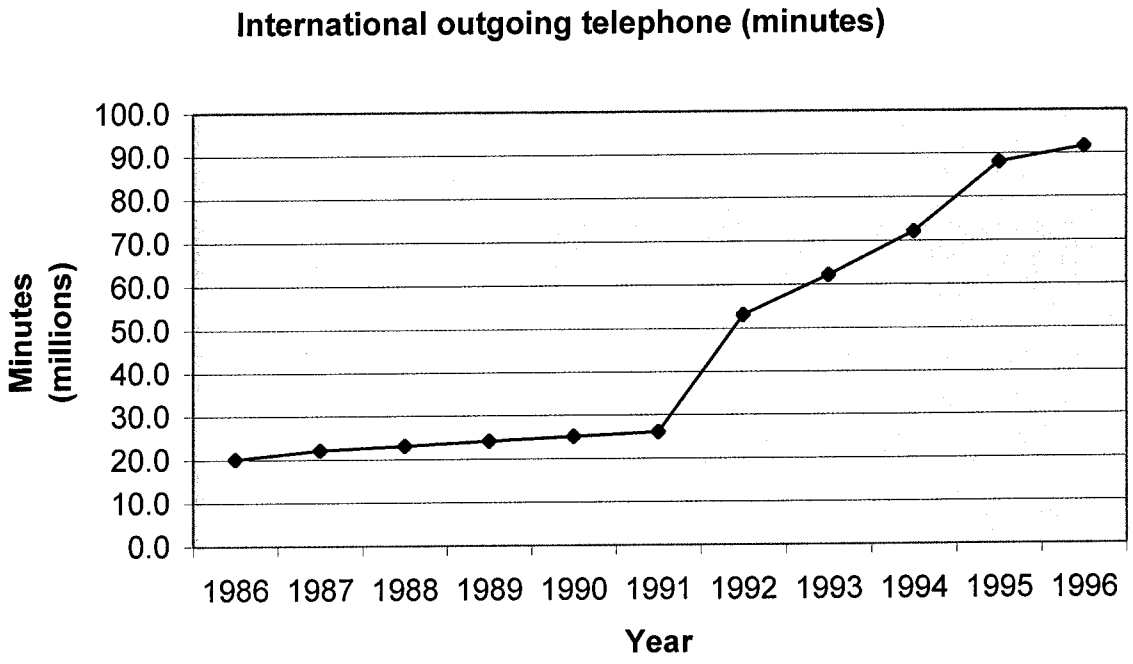


Table 3-9: International outgoing telephone (minutes)

Year	No. of Lines (millions)
1986	20.0
1987	22.0
1988	23.0
1989	24.0
1990	25.0
1991	26.0
1992	53.0
1993	62.0
1994	72.0
1995	88.0
1996	91.5

Source: International Telecommunications Union 1997 Statistics



Having examined the telephone traffic in the previous paragraph, further examination of the telephone lines in operation confirms the situation. There is a slow growth in the number of total lines at a rate less than 200,000 per year through 1996.

But there is a strong demand for additional telephone lines unserviced by the steady level of the installation rate. The waiting list for service stood at 1,299,000 in 1996 and has stood at a level of 1.3 million unserved subscribers since 1993 (Table 3-10). It appears that the installation of 160,000 to 200,000 new lines per year is in equilibrium with the queue of subscribers awaiting service.

Examining the data further, we find that the percent of residential lines has decreased since 1989 (Table 3-11). There must be a disproportionate share of business lines being installed to support Romania's growing economy. Reference to the percent digital lines installed and community information confirms this trend (Table 3-12). The first digital lines installed were in 1991, immediately after the Revolution, and have grown dramatically, particularly since 1994. Business lines are connected to the new digital exchanges while older residential lines remain in analog exchanges.

Looking now at total revenues and individual tariffs, we see another picture of the residential vs. business aspects of Rom Telecom's system. If one looks at the 1996 tariff structure, one finds it strongly based on business income (Table 3-13).

Rom Telecom's tariff structure is now subject to quarterly adjustment. Therefore the figures in Table 3-13 do not represent current prices, however, the business - residential differential remains. For example, Rom Telecom's residential monthly charge allows for 100 free impulses and a charge of $0.03 per impulse beyond 100 impulses. On the other hand, the business telephone has no free impulse allowance.

The World Bank reports that 75% of Rom Telecom's revenues are derived from its business telephone service even though business lines comprise only 12% of Rom Telecom's connections.

Considering Rom Telecom's distribution of revenue, it is not surprising that business services are growing and residential services are subjected to a waiting list one third the size of total installed telephone lines and exhibit a low service growth rate.

Table 3-10: Waiting list for main lines

Year	Number (thousands)
1986	720
1987	727
1988	724
1989	754
1990	980
1991	1027
1992	1181
1993	1320
1994	1289
1995	1265
1996	1299

Source: International Telecommunications Union 1997 Statistics

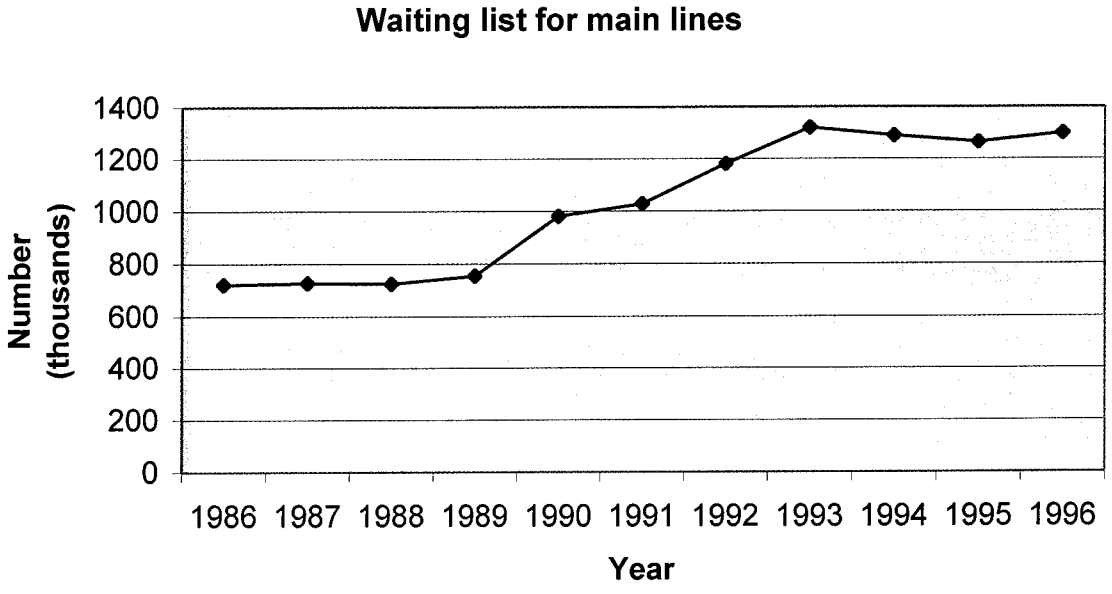


Table 3-11: Percentage residential main lines

Year	Percentage
1986	91.7%
1987	91.7%
1988	92.0%
1989	92.4%
1990	92.0%
1991	91.6%
1992	91.0%
1993	90.6%
1994	90.6%
1995	90.5%
1996	88.7%

Source: International Telecommunications Union 1997 Statistics

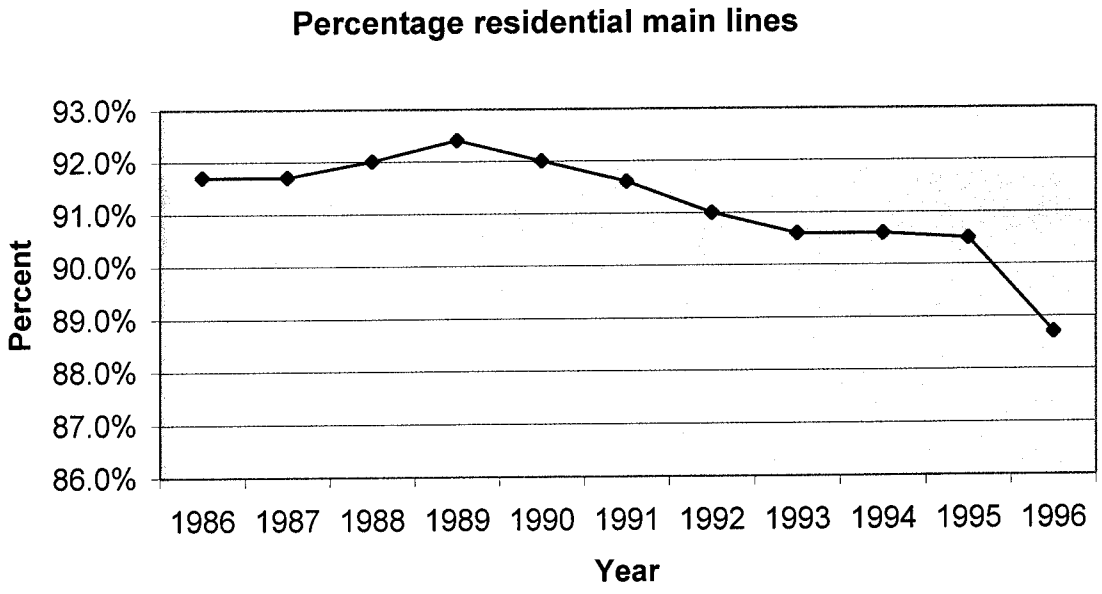


Table 3-12: Percentage digital main lines

Year	Percentage
1991	0.4%
1992	0.4%
1993	2.1%
1994	7.0%
1995	15.7%
1996	22.5%

Source: International Telecommunications Union 1997 Statistics

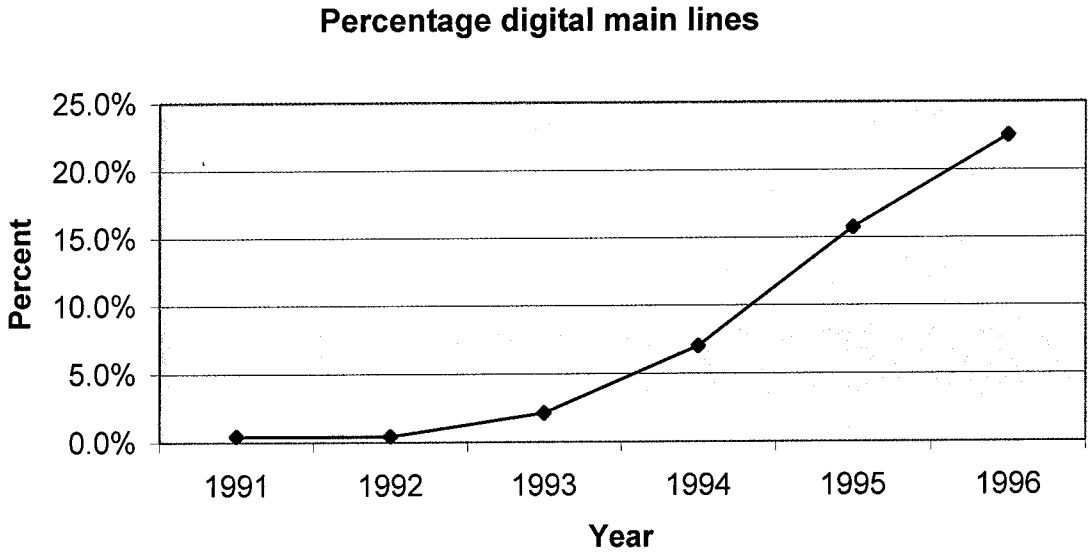


Table 3-13: Rom Telecom Revenues and Sample Tariffs

REVENUES	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Total Telecom Revenue-US$M	609	701	764	705	463	245	157	273	291	423	560
TARIFFS-US$											
Residential Tel. Connection	--	--	--	--	45	47	16	25	27	49	49
Business Tel. Connection	--	--	--	--	--	--	24	99	108	172	130
Analog Cellular Connection	--	--	--	--	--	--	--	494	315	241	241
Residential Tel. Monthly Charge	--	--	--	--	2.2	1.7	1.6	1.3	1.2	1.2	1.6
Business Tel. Monthly Charge	--	--	--	--	--	--	10.4	20.5	16.8	19.7	26.2
Analog Cellular Monthly Charge	--	--	--	--	--	--	--	42	25	32	32

Source: 1986-1995 statistics: ITU; ***1997 ITU Statistical Yearbook***; Geneva, Switzerland.
1996 statistics: ITU; ***1998 ITU World Telecommunications Development Report***.

To better illustrate and understand the nature of existing telephone charges and revenues, sample monthly invoices for a residential line and a business line are presented in Appendix 3-A along with an in-depth telephone billing report, showing a sample of international calling patterns.

C. SNCFR STRENGTHS, WEAKNESSES, OPPORTUNITIES AND RISKS

SNCFR Strengths

Modern transmission system. Upon completion of SNCFR's 3,600 km fiber optic transmission system and conversion to digital switching equipment, SNCFR Telecom will possess one of the most modern telecommunications backbones in Romania. This places SNCFR Telecom in a position to offer higher quality transmission services than any other provider. This quality will be particularly important in attracting data transmission subscribers.

Digital switches. The core of SNCFR Telecom's system will operate through digital switches. Transmissions will suffer much less distortion; countless special features can be added to the switch though software changes; and cost of maintenance will be substantially lower than in the older electro-mechanical equipment.

Quality of transmission. A key feature of fiber optic transmission is its high quality. The technology is also very versatile, allowing participation in data, voice, and video markets all through the same fiber at the same time.

National coverage. Complete coverage of the country is important for subscriber access at each end of the transmission. Regional providers have a severe handicap and limited revenues in marketing their services. SNCFR Telecom is the only competing telecommunications provider that can maintain nationwide coverage.

Excess capacity. SNCFR Telecom will have a large amount of excess capacity to sell. Approximately 10 of its 20 optic fibers will be used for railway transmissions. The remaining 10 fibers are roughly equivalent to one-half (or more) of Rom Telecom's capacity depending upon the transmission equipment utilized.

SNCFR Weaknesses

No local access. SNCFR is totally dependent on Rom Telecom and others for local access to subscribers that may transmit over its system. Furthermore, much of the access that can be reached over Rom Telecom's local loops travels on obsolete or degraded systems so that the customer does not receive the quality of SNCFR Telecom's facilities or services.

Obsolete technical skills. SNCFR Telecom's staff competence lies in maintenance and servicing obsolete, electro-mechanical step-by-step switches and copper cables. Extensive training and new hires are going to be required to maintain and operate the new digital, fiber optic system.

Few commercial management skills. SNCFR Telecom has very little experience in handling the needs and demands of the commercial market place. To overcome an otherwise long and troublesome learning curve, additional management with outside commercial experience must be brought in and combined with SNCFR Telecom's technical skills.

No sales or marketing staff. A critical part of the commercialization of SNCFR Telecom will be the development of a sales and marketing staff. Without visibility and presence in the commercial telecom market place, SNCFR will have few customers. This visibility and presence also needs good direction from a professional marketing team to focus sales on the most likely clients with highest revenue and profit potential for SNCFR. These are skills that are most likely to be obtained from a commercial partner.

Restricted access to market (regulation). The Romanian telecommunications market is subject to Government regulation that protects the monopoly position of Rom Telecom in the public "voice" market until December 31, 2002. Other services, such as data or satellite services, can be offered but are controlled by Government licensing. SNCFR Telecom has not yet become involved in the licensing of these early perimeter markets.

Insufficient funding. Expansion into the commercial market will require additional funding. SNCFR Telecom does not have these sources of funding. Probable funding will come from the private sector and entail a private partner.

Opportunities for SNCFR

Deregulation. Deregulation of the Romanian telecommunications industry presents huge opportunities (and risks) for competitive providers in the Romanian economy. The key feature of deregulation is open access to subscribers. This model has met with success in the U.S. and several other world economies. Without access, SNCFR Telecom (or any other provider) is severely limited in its potential market size.

Commercial partner. Finding a suitable commercial partner for SNCFR Telecom can allow fast import of the skills needed to operate a commercial telephone system. Such actions will place SNCFR Telecom in a position to effectively compete before the advent of deregulation.

Funding partner(s). Locating a private sector partner, or partners, with adequate funds to invest in a telecommunications operation will strengthen SNCFR's position. Upon or prior to deregulation, SNCFR Telecom is going to have to consider: (1)additional equipment modernization; (2) market expansion in switch capacities or local loops; (3)support of a commercial as well as a technical staff; and (4) creation of its own working capital.

Railway reorganization. The time is at hand to seriously consider SNCFR Telecom's organizational relationship to the Railway. ***In becoming a commercial organization with outside income, SNCFR Telecom must become an independent unit, at least in an accounting sense***. The change will require a schedule of charges for services furnished to the Railway and performance agreements to protect the Railway's needs. ***These organizational changes need to be made now as the Railway itself is undergoing structural change***.

The organizational change becomes even more demanding as commercial and funding partners are brought into consideration. These partners can be expected to want participation in management. SNCFR, in turn, will have part ownership and services from a well-managed telecommunications service company. Ownership of Government patrimony will have to be protected by appropriate agreements. It is not too early to start on this overall process.

Quality of service. SNCFR Telecom will have a higher quality telecommunications system than its competitors. The sales and marketing staff should capitalize on this feature.

Pricing. Rom Telecom appears to have a very high priced and distorted tariff structure. The business tariffs are known to be high, and the residential tariffs, while substantially lower, are also high (in relation to personal income). These differences will provide opportunities for the sales and marketing strategy. The data transmission market appears ready-made for SNCFR Telecom; the residential market, with effective internal cost control, could develop significant traffic.

Market penetration. Telephone penetration rate in Romania is only 15% and moving up very slowly. The country's goal is a 30% penetration rate (by 2003), a large and expensive endeavor for Rom Telecom. Additional providers in the economy can participate in this potential increased volume once the regulatory barriers are lowered.

Undeveloped access loops. Romania badly needs additional and better quality access loops for its basic telephone service. SNCFR Telecom could explore the possibilities of providing selected local loops using modern, lower cost technologies. This is being done already by some of the limited service providers that have entered the market. Another possibility is to form alliances with smaller companies that provide local loop services.

Degraded access loops. A significant portion of Rom Telecom's local loop facilities are in a state of degraded maintenance. Competitive, alternative services to these conditions represent a significant market potential.

Niche Markets. Listed below are a variety of specialized services that could be offered to potential subscribers or which services could utilize SNCFR Telecom for trunk line transport:

- Private data networks
- Internet access providers
- Satellite operators
- Paging operators
- Cellular operations
- Mobile radio operations
- Rural local loops or connection services
- Public telephone offices
- Lease lines
- Overflow carrier services
- Video conferencing
- Value added services (to include innovative, customer tailored software)
- Connection to specialty operators

Risks for SNCFR

Cost of access. While the Romanian law stipulates open access between providers, it does not specifically name the price of access. The ITU principles would give the access provider the right to cover his access costs. Rom Telecom appears to be an expensive provider and could pass on its high costs in prohibitive access fees, thus retaining its monopoly.

Condition of access facilities. Even with open access at a reasonable price, quality of service through Rom Telecom access loops and equipment may be poor or obsolete, negating the advantages of a trunk line provider's quality services. This situation will vary with business subscriber access through new digital switches connected to better access lines and residential subscribers situated on analog systems served through electro-mechanical step-by-step switches connected to older, poorly maintained copper wires.

Rules of access. The overview of deregulation has been spelled out in legislation. The reality of deregulation, however, will depend upon the rules and decisions established by the GIC (General Inspectorate of Communications). Any aspiring telecommunications provider in a deregulated market should be working with the GIC now to make sure that restrictive rules are not put into place, which in effect will continue non-competitive practices.

Price of access. A major threat to any potential provider is that the price of access to other systems, particularly Rom Telecom, will tend to be restrictive. Rom Telecom's cost recovery factors, accounting practices and seemingly high costs can be used to exclude significant traffic from other providers by pricing mechanisms, leaving Rom Telecom in a substantial monopoly position. The GIC must be the arbitrator at this sensitive interface between telecommunications providers.

Overbuild of Rom Telecom network. It is estimated in some quarters that Rom Telecom has overbuilt its trunk line network by a considerable factor. If this is so, there will be a large cost recovery factor in Rom Telecom's pricing that they will attempt to recover from others. ITU tariff principles will require such cost recovery, subject to national policy. Given the sunk cost and the network capacity, Rom Telecom would attempt to price down for its internal customers and retain as much volume of traffic as possible.

Other competitors. Other competitors are already in the market ahead of SNCFR Telecom. These competitors seem small and are largely in niche markets such as banking data transfers or internet access line via satellite operations. Some of these operations have already installed fiber optic local loops and trunk lines in lieu of Rom Telecom lease lines. These are potential SNCFR Telecom customers or partners who are already making investments and going their own way. A list of other known service providers in Romania is included in Appendix 1-A.

Timing of market entry. SNCFR Telecom cannot wait until 2003 to enter the market. Other entrepreneurial operators, including international telephone companies, are already in the Romanian market. SNCFR must acquire licenses and subscribers soon in order to build up its commercial expertise, stop the erosion of the potential market in to the hands of others and be completely ready on the day of deregulation. An early decision by the Government to advance the date of deregulation would be fortuitous for the nation and its supporting telecommunications infrastructure. SNCFR Telecom must be ready if that happens.

Costs. Control of operating costs and capital recovery factors will be a large element in SNCFR Telecom's ability to compete. SNCFR must endeavor to be a low cost - high volume carrier. SNCFR has serious work to do in reorganization and reduction of its staff without losing telecom quality or responsiveness. Similarly, excessive capital cost must be watched, keeping in mind that an error in capital acquisition will take years to overcome, while an error in staff size can be corrected in a matter of months by an alert management.

The Romanian economy. Romania's economy should in time support a much wider and more modern telecommunications network. However, incomes are still relatively low and disposable income will not yet support the depth of telephone subscriber penetration found in the Western economies. SNCFR Telecom may find that the general economy cannot fully support the more extensive telecommunications infrastructure desired by the Government at this time.

D. TARIFFS

International Telecommunications Union (ITU)

The ITU publishes an extensive set of documents called "General Tariff Principles" which covers an extremely wide set of subjects, both national and international. This document set has been furnished to SNCFR on CD ROM for use in reviewing or establishing SNCFR's own tariff structure. An index of these documents is provided as Appendix 3-B for initial reference.

The scope of these documents far exceeds the ability of this report to include over the numerous details covered. However, the general nature of the ITU documents can be summarized as follows:

- Tariffs should always be based upon the costs incurred.
- All costs must be covered by the totality of the system's charges.
- Socially desirable rates may be charged so long as system total costs are covered by revenues from other services (this conflicts with Romanian law).

- National rules and regulations supercede the ITU Tariff Principles.
- The originating carrier is responsible for billing.
- Charges divided between two or more carriers are to be settled by negotiation but a sense of equity and reciprocity should prevail.

SNCFR intends to subscribe to the general principles outlined in the ITU documents. For a more complete understanding, the actual documents should be referenced using the Index in Appendix 3-B to select specific subject matter.

A number of variations regarding the collection and settlement of accounts are included in the "General Tariff Principles". These become increasingly important for international traffic. SNCFR Telecom should plan for an accounting and payments department to handle this increased work load.

Existing Tariffs

SNCFR already has a tariff for handling of its 2,000 private subscribers. These tariffs are modeled after and are comparable to the Rom Telecom tariffs line-for-line.

Rom Telecom tariffs presumably follow ITU principles. Therefore, it is assumed that they cover costs. Rom Telecom's costs and cost allocation methods are unknown. The records are confidential and unavailable outside the Ministry of Communications. Whether Rom Telecom is profitable or inefficient is not known.

It is suggested that SNCFR construct a surrogate cost allocation against its own tariffs to evaluate Rom Telecom's position. The Railway revenues would also have to be adjusted upward to reflect Rom Telecom's much higher level of traffic.

APPENDIX 3-A

Samples of Rom Telecom Billing

FACTURA NR.: 0002352284 /APR 1998 *COD ABONAT* R41[illegible]5083

ROM TELECOM R.A.

DIRECŢIA DE TELECOMUNICAŢII BUCUREŞTI

70101 CAL. VICTORIEI 25, S1

Nr. Reg.Comerţului J 40/8926/1997

Cont: 25110117285000025002-BANC POST

Cod Fiscal: 427320 REPREZENTANTA

[illegible] MARIA MAGDALENA

STR [illegible] ET 1 AP 2

712191 BUCUREŞTI S1

127A SP S3 Cont:

Cod Fiscal: Bancă

☎ 2301582 63 | PERIOADĂ ABONAMENTE ÎNCHIRIERI 1.05-31.05 | PERIOADĂ ALTE SERVICII 14.04-13.05 | Garanţii

LINIE TF. PRINCIPALA	30000.00	MOD.TARIF APARATAJ APR		50,00
APARATAJ TF	700.00	MOD.TARIF SERVICE APR		100,00
SERVICE -	1700.00			
MOD.TARIF LINIE PR. APR	5000.00			

ALTE SERVICII		SUMA	ALTE SERVICII	SUMA
IMPULSURI	100*0LEI	0,00		
IMPULSURI	2435*210LEI	511350,00		
ANUNT ORA FIXA		500,00		
FACTURA DETALIATA		6000,00		

TVA %	22	MAJORARI CU TVA		TOTAL ABONAMENTE ÎNCHIRIERI	37350,00	TOTAL ALTE SERVICII	517850,00
TOTAL FACTURAT FĂRĂ TVA	455245,91	TVA	100154,09	TOTAL FACTURAT CU TVA	555400,00		
FACTURA PRECEDENTĂ	1698250,00	ÎNCASĂRI	-1698250,00	SOLD	0,00		
0,30	-0,30	20 APR 1998	16	555400,00			
Rotunjire precedentă	Rotunjire curentă	SCADENT		TOTAL PLATĂ LEI			

FACTURA NR.: 0002389274 /APR 1998

ROM TELECOM S.A.
DIRECŢIA DE TELECOMUNICAŢII BUCURESTI
70101 CAL. VICTORIEI 35, S1
Nr. Reg.Comerţului J 40/8926/1997
Cont: 2511011728300000025002-BANC POST
Cod Fiscal: 427320 REPREZENTANTA

COD ABONAT J4170000354911
S.C. CONEX INTRADE SRL
BD Carol I 25 A
703321 BUCURESTI S2
405B OF 37 Cont: 4072102163
Cod Fiscal: Bancă BCR SECTOR 1

☎ J41/000035491 PERIOADĂ ABONAMENTE ÎNCHIRIERI 1.04-30.04 PERIOADĂ ALTE SERVICII 1.03-31.03 Garanţii 570000

LINIE TF. PRINCIPALA	90000,00
LINIE SUPLIMENTARA	13500,00
CHIRII TERMINALE	7000,00

ALTE SERVICII	SUMA	ALTE SERVICII	SUMA
IMPULSURI	615300,00		
CONV.AUT EXTERNE	2154180,00		
ANEXA LA FACTURA	18800,00		
TAXE POSTALE	1300,00		

TVA %	22	MAJORĂRI CU TVA	86335	TOTAL ABONAMENTE ÎNCHIRIERI	110500,00	TOTAL ALTE SERVICII	2789580,00
TOTAL FACTURAT FĂRĂ TVA	2447881,15	TVA	538533,85	TOTAL FACTURAT CU TVA	2986415,00		
FACTURA PRECEDENTĂ	4791220,00	ÎNCASĂRI	-2240675,00	SOLD	2550545,00		
4,20	-4,20	25 APR 1998	03		5536960,00		
Rotunjire precedentă	Rotunjire curentă	SCADENT			TOTAL PLATĂ LEI		

TIPĂRIT de EUROGRAFICA S.R.L.

D.TC.D. PRESTATII 01.03.98/31.03.98
COD ABONAT: J417000035491 1 /PAG 1
S.C. CONEX INTRADE SRL

BD Cargl I 25 A 52
OF. 37 DIST 405B

9211 3004 MAJORARE
0101 2503 FACTURA PREC
0401 0503 INCAS NUMERAR
1830 8800 ANEXA FACTURA
7101 0104 TAXE POSTALE AV
9111 2503 RDT PRECEDENTA
9112 0904 RDT CURENTA

3121320
1101 3104 AB.LINIE PRINCI
1103 3104 AB.LSP.INT.
1473 0303 3103 881
1510 1703 Ungaria 1#
1510 2003 Ungaria 1#
1510 2303 Ungaria 1#
1510 2503 Ungaria 1#
1510 2603 Germania 1#
1510 2603 Germania 1#
1510 2603 Ungaria 1#
1510 2603 Ungaria 1#
1510 3003 Germania 1#
1510 3103 Germania 1#

3124992
1101 3104 AB.LINIE PRINCI
1473 0203 3103 2008
1510 0203 Germania 1#
1510 0203 Germania 1#
1510 0203 Germania 1#
1510 0203 Germania 1#
1510 0203 Germania 1#
1510 0203 Italia 1#
1510 0203 Ungaria 1#
1510 0303 Austria 1#
1510 0303 Germania 1#
1510 0303 Italia 1#
1510 0303 Ungaria 1#
1510 0303 Ungaria 1#
1510 0303 Ungaria 1#
1510 0603 Austria 1#
1510 0603 Germania 1#
1510 0603 Germania 1#
1510 0603 Germania 1#
1510 0603 Germania 1#
1510 0703 Austria 1#
1510 0703 Germania 1#
1510 0903 Ungaria 1#
1510 0903 Ungaria 1#
1510 0903 Ungaria 1#
1510 0903 Ungaria 1#
1510 1003 Austria 1#
1510 1003 Germania 1#
1510 1003 Germania 1#
1510 1003 Germania 1#
1510 1003 Germania 1#
1510 1103 Germania 1#
1510 1103 Germania 1#
1510 1103 Ungaria 1#
1510 1203 Austria 1#
1510 1203 Austria 1#
1510 1203 Germania 1#

86335
479[illegible]
-22[illegible]

9,20
-4,20
2656980.00

30000
9000
185010
21390
38640
17940
46920
12420
15180
11040
5520
17940
10350
421350.00

30000
421680
690
8280
4140
43470
17250
7590
86250
7590
27600
9660
690
57960
11730
3450
4830
30360
8280
18630
4140
4140
8970
29670
8280
31050
45540
1380
57960
690
6900
690
20700
21390
28980
26910
1380

1510 1203 Germania 1# 2070
1510 1203 Germania 1# 2760
1510 1203 Germania 1# 690
1510 1203 Germania 1# 4140
1510 1203 Germania 1# 4830
1510 1203 Germania 1# 1380
1510 1203 Germania 1# 8970
1510 1303 Germania 1# 11730
1510 1303 Ungaria 1# 18630
1510 1303 Ungaria 1# 47610
1510 1603 Germania 1# 35190
1510 1603 Germania 1# 3450
1510 1603 Germania 1# 35880
1510 1603 Germania 1# 8280
1510 1703 Germania 1# 11040
1510 1703 Germania 1# 2070
1510 1703 Germania 1# 1380
1510 1703 Italia 1# 14490
1510 1703 Ungaria 1# 8970
1510 1703 Ungaria 1# 65550
1510 1703 Ungaria 1# 8970
1510 1703 Ungaria 1# 10350
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1510 1703 Ungaria 1# 32430
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1510 1703 Ungaria 1# 8280
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1510 1703 Ungaria 1# 21390
1510 1703 Ungaria 1# 22770
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1510 1903 Germania 1# 2070
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1510 1903 Germania 1# 8970
1510 1903 Italia 1# 7590
1510 1903 Italia 1# 76590
1510 2003 Italia 1# 3450
1510 2003 Ungaria 1# 20010
1510 2003 Ungaria 1# 25530
1510 2003 Ungaria 1# 15870
1510 2003 Ungaria 1# 20010
1510 2003 Ungaria 1# 8970
1510 2003 Ungaria 1# 8970
1510 2303 Germania 1# 8970
1510 2303 Germania 1# 690
1510 2303 Germania 1# 2070
1510 2303 Germania 1# 1380
1510 2303 Italia 1# 3450
1510 2303 Ungaria 1# 8970
1510 2403 Germania 1# 12420
1510 2403 Germania 1# 1380
1510 2403 Germania 1# 7590
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1510 2403 Italia 1# 35190
1510 2403 Ungaria 1# 8970
1510 2503 Germania 1# 22080
1510 2503 Germania 1# 19320
1510 2503 Ungaria 1# 2760
1510 2503 Ungaria 1# 2760
1510 2503 Ungaria 1# 7590
1510 2503 Ungaria 1# 48990
1510 2503 Ungaria 1# 28980
1510 2503 Ungaria 1# 7590
1510 2503 Ungaria 1# 95220
1510 2503 Ungaria 1# 14490
1510 2503 Ungaria 1# 1380
1510 2503 Ungaria 1# 30360
1510 2503 Ungaria 1# 38640

COD ABONAT: J417000035491 1 /PAG 2
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1510 2503 Ungaria 1# 3450
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1510 3003 Italia 1# 1380
1510 3003 Ungaria 1# 14490
1510 3003 Ungaria 1# 8970
1510 3103 Germania 1# 6900
1510 3103 Germania 1# 2070
1510 3103 Italia 1# 12420
1510 3103 Ungaria 1# 8970
2408520.00

6130302
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1103 3104 AB.LSP.INT. 4500
1131 3104 INCH. ECHIP.TER 7000
1404 3601 2502 58791 38740 (41) 8610
1453 3601 2502 41 50110.00

TOTAL COD ABONAT [illegible].00

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D.T.C.D. PRESTATII 01.03.98/31.03.98
COD ABONAT: J417000035491 1 /PAG 1
S.C. CONEX INTRADE SRL

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OF. 37 DIST 405B

9211 3004 MAJORARE
0101 2503 FACTURA PREC 86335
0401 0703 INCAS NUMERAR 4791220
1930 3303 ANEXA FACTURA -2240675,00
7101 2104 TAXE POSTALE AV 18800
9111 2503 ROT PRECEDENTA 1300
9112 0304 ROT CURENTA 4,20
-4,20
2656980,00

3121320
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1103 3104 AB.LSP.INT. 9000
1473 0303 3103 881 185010
1510 1703 Ungaria 1# 21390
1510 2003 Ungaria 1# 38640
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1510 2503 Ungaria 1# 46920
1510 3603 Germania 1# 12420
1510 3603 Germania 1# 15180
1510 3603 Ungaria 1# 11040
1510 3603 Ungaria 1# 3520
1510 3003 Germania 1# 17940
1510 3103 Germania 1# 10350
421350,00

3124972
1101 3104 AB.LINIE PRINCI 30000
1473 0203 3103 2008 421680
1510 0203 Germania 1# 690
1510 0203 Germania 1# 8280
1510 0203 Germania 1# 4140
1510 0203 Germania 1# 43470
1510 0203 Germania 1# 17250
1510 0203 Italia 1# 7590
1510 0203 Ungaria 1# 86250
1510 0303 Austria 1# 7590
1510 0303 Germania 1# 27600
1510 0303 Italia 1# 9660
1510 0303 Ungaria 1# [illegible]0
1510 0303 Ungaria 1# 5[illegible]0
1510 0303 Ungaria 1# 11730
1510 0603 Austria 1# 3450
1510 0603 Germania 1# 4830
1510 0603 Germania 1# 30360
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2408520,00

PAG 10407

6130303
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1103 3104 AB.LSP.INT. 4500
1131 3104 INCH. ECHIP.TER 7000
1404 3e01 3303 58791 38740 (41) 8610
1403 3e01 3303 41 50110,00

TOTAL COD ABONAT 5336960,00

APPENDIX 3-B

ITU-T Recommendations Series D - Index

B0019E.ZIP	26KB	10/96	B.19 - Abbreviations and initials used in telecommunications

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Series C - *General telecommunication statistics*

C0001E.ZIP	29KB	03/93	C.1 - ITU statistical yearbook
C0002E.ZIP	26KB	10/96	C.2 - Collection and dissemination of official service information
C0003E.ZIP	21KB	03/93	C.3 - Instructions for international telecommunication services

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D-S03E.ZIP	217KB	03/93	D.Supplement 03 - Handbook on the methodology for determining costs and establishing national tariffs
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D0001E.ZIP	72KB	07/91	D.1 - General principles for the lease of international (continental and intercontinental) private telecommunication circuits and networks
D0003E.ZIP	32KB	06/92	D.3 - Principles for the lease of analogue international circuits for private service
D0004E.ZIP	71KB	07/96	D.4 - Special conditions for the lease of international (continental and intercontinental) sound- and television-programme circuits for private service
D0005E.ZIP	20KB	11/88	D.5 - Costs and value of services rendered as factors in the fixing of rates
D0007E.ZIP	33KB	01/92	D.7 - Concept and implementation of "one-stop shopping" for international private leased telecommunication circuits
D0008E.ZIP	21KB	11/88	D.8 - Special conditions for the lease of international end-to-end digital circuits for private service
D0009E.ZIP	21KB	11/88	D.9 - Private leasing of transmitters or receivers
D0010E.ZIP	33KB	07/91	D.10 - General tariff principles for international public data communication services
D0011E.ZIP	57KB	03/91	D.11 - Special tariff principles for international packet-switched public data communication services by means of the virtual call facility
D0012E.ZIP	21KB	11/80	D.12 - Measurement unit for charging by volume in the international packet-switched data communication service
D0013E.ZIP	21KB	10/84	D.13 - Guiding principles to govern the apportionment of accounting rates in international packet-switched public data communication relations
D0015E.ZIP	21KB	11/88	D.15 - General charging and accounting principles for non-voice services provided by interworking between public data networks
D0020E.ZIP	23KB	11/80	D.20 - Special tariff principles for the international circuit-switched public data communication services
			D.21 - Special tariff principles for short

D0021E.ZIP	20KB	11/88	transaction transmissions on the international packet switched public data networks using the fast select facility with restriction
D0030E.ZIP	26KB	10/84	D.30 - Implementation of reverse charging on international public data communication services
D0035E.ZIP	32KB	01/92	D.35 - General charging principles in the international public message handling services and associated applications
D0036E.ZIP	42KB	03/95	D.36 - General accounting principles applicable to message handling services and associated applications
D0037E.ZIP	52KB	07/96	D.37 - Accounting and settlement principles applicable to the provision of public directory services between interconnected Directory Management Domains
D0040E.ZIP	35KB	06/92	D.40 - General tariff principles applicable to telegrams exchanged in the international public telegram service
D0041E.ZIP	80KB	11/80	D.41 - Introduction of accounting rates by zones in the international public telegram service
D0042E.ZIP	23KB	11/88	D.42 - Accounting in the international public telegram service
D0043E.ZIP	25KB	11/88	D.43 - Partial and total refund of charges in the international public telegram service
D0045E.ZIP	32KB	06/92	D.45 - Charging and accounting principles for the international telemessage service
D0060E.ZIP	32KB	07/91	D.60 - Guiding principles to govern the apportionment of accounting rates in intercontinental telex relations
D0061E.ZIP	22KB	11/88	D.61 - Charging and accounting provisions relating to the measurement of the chargeable duration of a telex call
D0065E.ZIP	22KB	11/88	D.65 - General charging and accounting principles in the international telex service for multi-address messages via store-and-forward units
D0067E.ZIP	34KB	03/95	D.67 - Charging and accounting in the international telex service
D0070E.ZIP	34KB	06/92	D.70 - General tariff principles for the international public facsimile service between public bureaux (bureaufax service)
D0071E.ZIP	32KB	06/92	D.71 - General tariff principles for the public facsimile service between subscriber stations (telefax service)
D0073E.ZIP	33KB	06/92	D.73 - General tariff and international accounting principles for interworking between the international bureaufax and telefax services
D0079E.ZIP	57KB	07/91	D.79 - Charging and accounting principles in the international videotex service
D0080E.ZIP	22KB	11/88	D.80 - Accounting and refunds for phototelegrams
D0081E.ZIP	21KB	11/88	D.81 - Accounting and refunds for private phototelegraph calls
D0083E.ZIP	25KB	11/88	D.83 - Rates for phototelegrams and private phototelegraph calls
D0085E.ZIP	20KB	11/88	D.85 - Charging for international phototelegraph calls to multiple destinations
D0090E.ZIP	66KB	03/95	D.90 - Charging, billing, international accounting and settlement in the maritime mobile service
D0091E.ZIP	61KB	07/96	D.91 - Transmission in encoded form of maritime telecommunications accounting information
D0093E.ZIP	107KB	11/88	D.93 - Charging and accounting in the international land mobile telephone service 'provided via cellular radio systems)

D0094E.ZIP	33KB	01/92	D.94 - Charging, billing and accounting principles for international aeronautical mobile service, and international aeronautical mobile-satellite service
D0095E.ZIP	41KB	10/92	D.95 - Charging, billing, accounting and refunds in the data messaging land/maritime mobile-satellite service
D0098E.ZIP	23KB	03/93	D.98 - Title not available.
D0100E.ZIP	22KB	11/88	D.100 - Charging for international calls in manual or semi-automatic operating
D0103E.ZIP	31KB	06/92	D.103 - Charging in automatic service for calls terminating on a recorded announcement stating the reason for the call not being completed
D0104E.ZIP	20KB	11/88	D.104 - Charging for calls to subscriber's station connected either to the absent subscriber's service or to a device substituting a subscriber in his absence
D0105E.ZIP	20KB	12/72	D.105 - Charging for calls from or to a public call office
D0106E.ZIP	21KB	12/72	D.106 - Introduction of reduced rates during periods of light traffic in international telephone service
D0110E.ZIP	31KB	06/92	D.110 - Charging and accounting for conference calls
D0115E.ZIP	26KB	10/96	D.115 - Tariff principles and accounting for the International Freephone Service (IFS)
D0116E.ZIP	25KB	10/96	D.116 - Charging and accounting principles relating to the home country direct telephone service
D0120E.ZIP	27KB	07/96	D.120 - Charging and accounting principles for the international telecommunication charge card service
D0140E.ZIP	29KB	09/95	D.140 - Accounting rate principles for international telephone services
D0150E.ZIP	62KB	10/96	D.150 - New system for accounting in international telephony
D0151E.ZIP	21KB	12/72	D.151 - Old system for accounting in international telephony
D0155E.ZIP	27KB	07/96	D.155 - Guiding principles governing the apportionment of accounting rates in intercontinental telephone relations
D0160E.ZIP	25KB	11/88	D.160 - Mode of application of the flat-rate price procedure set forth in Recommendation D.67 and Recommendation D.150 for remuneration of facilities made available to the Administrations of other countries
D0170E.ZIP	37KB	03/95	D.170 - Monthly telephone and telex accounts
D0171E.ZIP	20KB	11/88	D.171 - Adjustments and refunds in the international telephone service
D0172E.ZIP	20KB	12/72	D.172 - Accounting for calls circulated over international routes for which accounting rates have not been established
D0173E.ZIP	20KB	11/88	D.173 - Defaulting subscribers
D0174E.ZIP	20KB	12/72	D.174 - Conventional transmission of information necessary for billing and accounting regarding collect and credit card calls
D0176CNE.ZIP	21KB	12/96	D.176 Notice - Title not available.
D0176E.ZIP	48KB	06/92	D.176 - Transmission in encoded form of telephone reversed charge billing and accounting information
D0177E.ZIP	20KB	11/88	D.177 - Adjustment of charges and refunds in the international telex service
D0178E.ZIP	21KB	03/93	D.178 - Monthly accounts for semi-automatic telephone calls (ordinary and urgent calls, with or without special facilities)

D0180C1E.ZIP	21KB	09/95	D.180 Corrigendum 1 - Corrigendum
D0180E.ZIP	61KB	09/95	D.180 - Occasional provision of circuits for international sound- and television-programme transmissions
D0185E.ZIP	23KB	11/88	D.185 - General tariff and accounting principles for international one-way point-to-multipoint satellite services
D0186E.ZIP	30KB	10/96	D.186 - General tariff and accounting principles for international two-way multipoint telecommunication service via satellite
D0188E.ZIP	34KB	10/92	D.188 - General charging and accounting principles applicable to an international videoconferencing service
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D0286E.ZIP	27KB	07/96	D.286 - Charging and accounting principles for the global virtual network service
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D0301RE.ZIP	33KB	03/95	D.301 R - Determination of accounting rate shares and collection charges in telex relations between countries in Europe and the Mediterranean Basin
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D0307RE.ZIP	24KB	03/95	D.307 R - Remuneration of digital systems and channels used in telecommunication relations between the countries of Europe and the Mediterranean Basin
D0310RE.ZIP	23KB	03/95	D.310 R - Determination of rentals for the lease of international programme (sound- and television-) circuits and associated control circuits for private service in relations between countries in Europe and the Mediterranean Basin
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D0500RE.ZIP	21KB	10/93	D.500 R - Accounting rates applicable to telephone relations between countries in Asia and Oceania
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D0601RE.ZIP	31KB	10/93	D.601 R - Determination of accounting rate shares and collection charges in telex relations between countries in Africa
D0606RE.ZIP	20KB	11/88	D.606 R - Preferential rates in telecommunication relations between countries in Africa

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SECTION 4:
MARKET ISSUES -
FINDINGS AND CONCLUSIONS

A. INTERNAL NEEDS

Existing Telecommunications System

SNCFR has a varied and demanding internal market for telecommunications services. Critical services that must be covered without fail are those that deal with control and command of train operations and traction power operations. These would include train radio services which form a working link for the timely execution of railway operations. While SNCFR Telecom will provide other basic services, these control and command functions must be, and are, covered without fail.

Other existing services include voice and limited data circuits. At the present level of usage, the voice circuits have reached their capacity and busy hour traffic meets significant blocking because of lack of trunk quality and capacity. This trunk traffic is currently handled in carrier circuits in buried copper cable.

Existing data services are provided in an analog X.25 mode, also in the buried copper cable. The X.25 traffic is routed through its own electronic switching since the basic electro-mechanical step-by-step switches are incapable of handling data traffic. However, the growing Railway demand for data communications, particularly the pending integrated MIS data system (IRIS) indicates that the existing telecom system is inadequate for future needs.

Planned SNCFR System Improvements

The key to the Railway's telecommunications capacity and quality limitations is a three-fold approach based on a fiber optic cable system, broad-band transmission equipment, and digital switching. The 3,600 km new fiber optic system will consist of 20 fibers in each loop of which approximately ten fibers are dedicated to the Railway's needs and the other fibers will be available for the external market. Transmission capability will vary according to traffic, with the key trunk lines operating at STM-16 and STM-4. Digital switches will be used throughout the fiber optic network and at some branch exchanges. Branch lines in low traffic areas

will retain their electro-mechanical step-by-step switches and analog transmission mode as a matter of economy.

A critical need for these telecom improvements is the Railway's pending integrated data system, IRIS, which is undergoing development on a three-year schedule in parallel with the fiber optic telecommunications system.

The planned telecommunications system is funded and currently starting construction. A pilot section of fiber optic has been in service between Bucharest and Ploiesti for four years. Contracts have been let for the purchase and installation of the fiber optic cable. Award of a contract for the fiber optic transmission equipment is expected shortly. Tender documents for the digital switching equipment are expected to go out this Autumn with bids closing near the end of 1998.

The planned ten-fiber railway system, when completed, will have more than enough capacity for foreseeable railway needs. The system will also have video and broadband capabilities. Although unlikely, the system could be further expanded by modifications to the transmission system.

The fiber optic system as installed will include approximately ten unused (dark) fibers for commercial services. Transmission equipment for these fibers is not being installed during the present construction cycle. This equipment can be designed and sized as the external market develops.

Potential System Improvements

A significant omission in the existing railway communications system is dispatcher-to-train radio. Present communications with trains is all conducted by the lineside stations. This system of control and command is obsolete. Early attempts have been made by the Railway for dispatcher-to-train radio, but the effort was abandoned in the 1990s.

Radio Replacement. A large percentage of SNCFR's 13,000 radios will need to be replaced. All 3,353 of the fixed radio stations need replacing. Also, the 2,040 radios in locomotive cabs may need to be replaced by the Traction Department.

Additional Fiber Optic Transmission Facilities. The fiber optic transmission network on SNCFR needs to be expanded to complete six additional rings. Three of these areas are on heavy traffic electrified lines and need to be constructed. They are between Timisoara and Filiasi, Adjud and Beclean pe Somes, and Cluj-Napoca and Oradea.

Additional Digital Switching Systems. The digital switching system needs to be expanded by replacing the remaining 27 old Basa and crossbar telephone switches that are over 30 years old and require high maintenance to keep in operation.

Railway Restructuring

The Railway is continuing rapidly with its restructuring program aimed at reducing overall employment and increasing productivity. ***A very important part of this restructuring must be the separation of the telecommunications operations from the Railway***. Telecommunications is currently part of the Infrastructure Directorate. ***With the impending entry of SNCFR Telecom into the commercial telecom market, telecommunications must attain an independent status from the Railway and be prepared to "sell" its services to the Railway as well as, other clients***.

The recent Railway restructuring affects not only telecommunications, but also separates the Railway into five other quasi-private operations involved in passenger, freight operations, and infrastructure. All of these units are going to require rearrangement of telecommunications lines, switches, and services.

Telecommunication Technological Trends (WDM)

A great deal of research is going on with optical fibers to optimize the number of transmission systems that can be carried on a single fiber pair. By shifting the dispersion of the fiber away from the 1550 nanometer window, up to eight transmission systems can be placed on the fiber pair using WDM (Wavelength Division Multiplexing). This fiber is being installed in United States today.

Wireless local loops are another trend which may lend itself to both the Railway's internal needs and the external market. The emerging wireless local loop technology greatly reduces the cost of access lines to the telecommunications network.

A third element of growth might be the potential adoption of the European EIRENE railway radio system and European ECTS railway signaling system. These advancements will allow data transmission to and from locomotives over secure data links that may involve both the fiber optic system and railway radio.

B. POTENTIAL EXTERNAL MARKETS

Excess SNCFR Telecom Capacity

The SNCFR fiber optic telecommunications system now being installed includes approximately ten unutilized fibers in the 3,600 km network. The network touches all the major cities in Romania. These extra fibers have not yet been fitted with transmission equipment. As such, the extra fibers are capable of STM-16, if required, and can also be multiplexed if the external market can be found to utilize such capacity.

Size of External Market

The size of the external market has been estimated from analysis of data collected in Romania and ITU statistics. This would place the national trunk line traffic in excess of 300 million call minutes per year; the outgoing international traffic in excess of 92 million minutes per year; and the incoming international traffic in excess of 120 million minutes per year. It is estimated that there are 3.5 million access lines connected to the public network in 1998. The growth rate of access lines has been in the nature of 200,000 lines per year. Government goals call for an increase in access line installation to 500,000 lines per year, doubling the public network size to about 6.8 million lines by 2003. Past performance and subscriber ability to pay would shed some doubt on such a goal. If such a goal was achieved, the telephone service penetration rate would be raised from the current 15.4% to 30%.

Figures 4-1 and 4-2 represent the total market size under two scenarios of market penetration by SNCFR. The blue line represents a flat internal capacity of 33,200 lines from the period from 2000 to 2008, and the red line represents the peak hour demand which consists of the internal and external needs. Figure 4-1 assumes 120,000 lines for the internal plus external markets in 2008, whereas Figure 4-2 assumes a more conservative estimate of 100,000 lines.

Figure 4-1: Total Installed Capacity vs. Peak Hour Demand

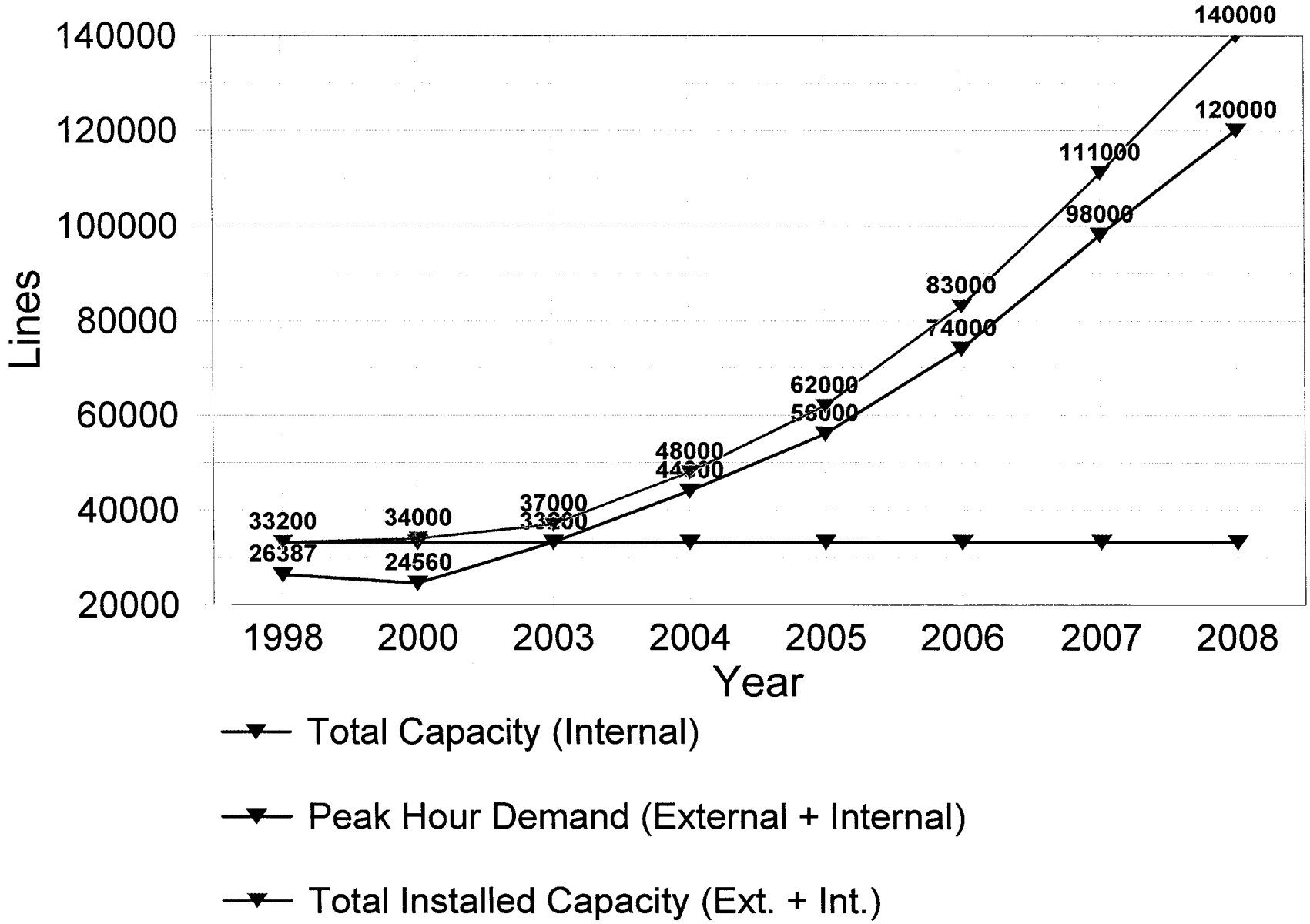
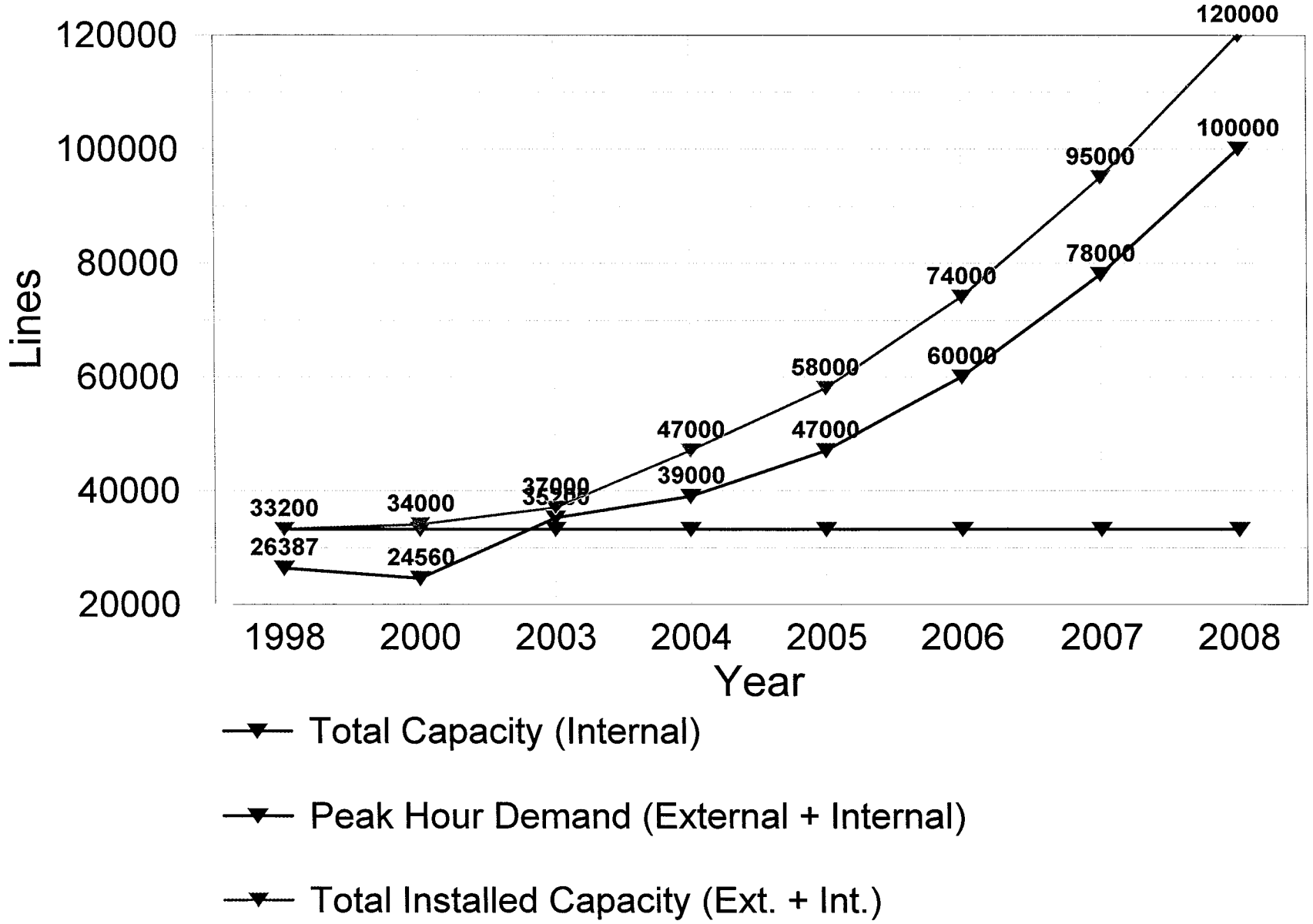


Figure 4-2: Total Installed Capacity vs. Peak Hour Demand



Nature of the External Market

Rom Telecom's most profitable market is long distance and international services sold to business accounts. The business lines amount to 12% of the telephone connections but produce 75% of Rom Telecom's revenues. A portion of the difference comes from higher monthly connection and service charges for business lines, but the overall reason has to do with the extensive use of telephone services by businesses.

There is a small component of peripheral business in cellular telephony, private data transfer, lease lines, Internet access, and VSAT services in which the service providers utilize Rom Telecom's network for access or for private trunk line transmission. These peripheral services are growing, but growth so far is restricted by limited licensing and protection of Rom Telecom's monopoly.

The large and neglected other market is the potential voice traffic from the approximate three million residential lines and their future growth. There is an ongoing waiting list of 1.3 million service requests, most of which are for residential service. The residential market segment comprises 88% of Rom Telecom's connections but only 25% of its revenues. The revenues are impacted by both lower monthly connection charges and lower service charges (e.g. cost per "pulse" where 1 pulse = 1 local minute) and particularly the low average per capita income.

Potential Revenues

A large amount of potential revenues for SNCFR Telecom's system are largely based on the Rom Telecom system. 1996 total revenues for Rom Telecom (last reported revenues) were $560 million and growing. The amount of these revenues that could be diverted to SNCFR Telecom are a matter of conjecture and require a concentrated sales and marketing effort. To put the question in perspective, ten percent of the Rom Telecom revenues is about $56 million. Gaining this, or any other share of the market, is subject to price competition, quality of service, features of service and an extensive sales effort.

One item seems obvious: SNCFR Telecom will need an international transit switch. Revenues, in addition to traffic diverted from Rom Telecom, will also be available from private subscribers and regional operators that prefer to connect to SNCFR Telecom instead of Rom Telecom.

External Market Entry

SNCFR Telecom's market entry is going to require a great deal of effort and commercial guidance. The obvious competitive tool is going to be price. Rom Telecom is thought to be high priced and high cost. Its internal accounts are not publicly available, but Rom Telecom's organizational history, age of infrastructure, protected market, and reported performance would lead to a high cost organization.

ITU General Tariff Principles, and good business practices counsel that tariffs should cover cost of service. Therefore, to be price competitive and achieve market share, SNCFR Telecom is going to have to become more sensitive to the productivity of both labor and assets.

SNCFR's trunk line network is expected to be equal to or better than Rom Telecom's network. It is newer and based on later technology. However, subscribers' perception of quality and service will only be as good as the traffic path over the weakest link. The weak link is Rom Telecom's access lines. Therefore, SNCFR Telecom must consider selective establishment of its own local loops or alliances with regional operations not connected to Rom Telecom. Installation of a SNCFR international transit switch will also be important in the capture of revenues.

Initial statements have indicated that SNCFR Telecom is looking for the data market to be its niche. But SNCFR Telecom is going to operate an expensive, high-capacity, multiple capability network which must gather maximum revenues at as low a cost as possible. The voice market must also be costed and considered.

A critical element in market entry is going to be a concentrated sales and marketing effort. The market is not going to just come to SNCFR. SNCFR must project a presence into the telecom market place and must also know how to select profitable subscribers to target as customers.

Partners and Organization

SNCFR's traditional railway organization is not going to be satisfactory in the commercial market place. SNCFR Telecom must earn its keep from its revenues, not from an annual budget allocation. Furthermore, costs must be balanced against these revenues. Additional funding will also be needed for additional equipment.

To accomplish these requirements, it is recommended that SNCFR Telecom acquire a joint partner from the private sector. The partner's role is to help bring SNCFR Telecom, as a successful operating entity, into the commercial world. The partner must contribute not only capital or operating funds, but also working knowledge of modern telecommunications operations and development, sales and marketing expertise and commercial financial management skills. The actual shares of ownership will be a matter of negotiation but must be done in a manner to protect SNCFR's interests.

Competitors

SNCFR Telecom's chief competitor will be Rom Telecom, due to the size of Rom Telecom's market and the need for SNCFR Telecom to acquire a significant part of that market to support its own operations. The competition will be based on price and service.

SNCFR Telecom will have other competitors too. Most prominent will be the private data services already in existence, particularly those that have already started to build their own terrestrial infrastructures. It is suggested that SNCFR Telecom should start forming alliances with these specialty providers wherever possible.

Satellite operators also form a set of competitors to SNCFR Telecom. These are important for international traffic and also for large national businesses such as banks. SNCFR Telecom's advantage in this area will be quality of transmission, but the quality issue must be effectively marketed to the potential subscribers .

Timing

The timing of SNCFR Telecom's entry into the market is crucial. Despite the Government's delay in creating a competitive market until 2003, organization to enter the market and acquisition of allowable licenses and subscribers need to be initiated early. If SNCFR Telecom is not organized soon, it will be difficult to position itself if deregulation proceeds as planned. SNCFR Telecom cannot afford the potential market loss by waiting until deregulation takes effect.

A companion timing problem is that SNCFR Telecom is not likely to have sufficient revenues to support itself in its early years of separation from the

Railway. Therefore, there is a period of undetermined length during which SNCFR's joint venture is likely to be in a loss position awaiting a buildup of its external market share.

Regulation

While Government policy talks of deregulation, the reality is that regulatory powers are most likely being transferred from the Ministry of Communications to a new Government body, the General Inspectorate of Communications (GIC). The GIC will regulate rates, similar to the U.S. Federal Communications Commission (FCC). The GIC will regulate the radio spectrum, and most importantly the GIC will administer the Romanian law governing deregulation and competition in the telecommunications industry.

It is important that SNCFR Telecom establish a dialogue with the regulating agency. The GIC must know SNCFR Telecom's position on telecommunication issues. Conversely, it is important that SNCFR Telecom knows GIC's policies and the reasons thereof. Gaining trust and understanding between the two organizations will take time. It is important to establish the dialogue now, well before the advent of deregulation.

Tariffs

The tariffs chosen to be followed by SNCFR Telecom should be those recommended by the ITU (International Telecommunications Union). The subject is complex, the ITU publishes a comprehensive set of general telecommunications recommendations one of which is "Series D - General Tariff Principles". Specific questions require reference to the written recommendations, but overall general guidelines include the following:

- Tariffs should be based upon costs.
- The totality of all costs should be covered by the tariffs.
- The ITU allows socially desirable, discounted rates so long as total system costs are met by raising rates elsewhere in the system.
- National rules and regulations supercede conflicts with the ITU recommendations.

SNCFR already has some familiarity with Rom Telecom tariff practices. SNCFR already publishes its own tariffs for private subscribers following ITU guidelines and knowledge of current Rom Telecom tariffs. It is recommended that SNCFR Telecom consider early development of competitive public tariffs, in conjunction with forecasted costs, to assess those parts of the telecom market in which it is likely to compete.

SECTION 5:
TECHNICAL ISSUES

A. INTRODUCTION

The purpose of this Section is to present an overview of existing system characteristics, the World Bank project components and recommended extensions as they relate to the relevant market and financial issues for SNCFR's entry into the commercial telecommunications market. The intent is not to provide a technical treatise of what technology exists now or what technology is planned or recommended for the future. In Sections 9 and 10, which will cover the financial issues, the cost implications of planned and recommended improvements will be addressed. With respect to the recommended technologies, copies of selected technical brochures of typical equipment of U.S. manufacturers have been provided under separate cover to SNCFR.

TERA has had extensive discussions with the appropriate telecommunications professionals of the Railway in regard to the weaknesses of the existing telecommunications system and the need for substantial improvements which has been the focus of the project jointly funded by the World Bank and the Government of Romania. ***The components in the project and the overall design with regard to geographic placement and equipment specifications are state of the art and appropriate for the contemplated Railway applications, as well as the external market suitability.***

Components of the system such as fiber optic cable have been appropriately designed for application beyond the Railway's internal telecommunications needs. If proper financial return is expected to be generated for repayment of the World Bank loan, then this excess capacity must be effectively utilized by providing service to customers external to the Railway.

Telecommunications facilities are capital intensive. Utilization of the assets must be maximized to fulfill debt servicing and provide a reasonable return on the Romanian Government's investment in these facilities. With this view in mind, under each of the three sub-sections below, our recommendations for system extensions are presented for allowing economic use of the excess capacity in external market applications.

B. THE WORLD BANK PROJECT OVERVIEW

A pilot fiber optic transmission network was installed about four years ago from Bucharest to Ploiesti, a distance of 62 km. This system is in operation using SDH (Synchronous Digital Hierarchy) and PDH (Plesiochronous Digital Hierarchy) transmission equipment and is performing according to specifications. The SNCFR Telecommunications System is being upgraded as a result of a SNCFR study approved by the World Bank. The financing for the telecommunications upgrade is provided by the:

- World Bank through a credit for acquisition of components, equipment, and materials; and
- Government of Romania for costs associated with installation, customs and other taxes

The study looked into the telecommunications requirements of the Railway and recommended the construction of a new fiber optic digital transmission network and a new digital switching network with integrated services. This upgrade is expected to provide new telecommunications facilities, which SNCFR so badly needs to support and carry on its railway telecommunications operations. The new fiber cable network will extend for 3,535 km of the main line of the railway right-of-way and will be able to supply the necessary circuits for expanded applications. With the installation of the 3,535 km of fiber optic cable, the Railway's fiber optic network will have a total length of 3,597 km.

The new system will eliminate all the major deficiencies of the old system in transmission and switching. High quality digital circuits will be available for any application the Railway is considering such as voice and data transmission, teleconferencing, rail dispatching over dedicated lines, radio base station control, high speed data transmission, video conferencing, facsimile transmission, and signaling and traction power control. The new digital system will provide for high speed data transmission of up to 155.52 Mbps between ATM (Asynchronous Transfer Mode) systems for the new IRIS (Integrated Railway Information System).

C. CABLE NETWORKS

Existing Copper Cable Network

The interurban copper cable transmission network is in poor physical condition and is gradually deteriorating in parallel with the quality of telecommunications over these circuits. Cable deterioration and low transmission quality are mainly caused by:

- Deferred maintenance in some segments;
- Lack of necessary materials for current maintenance;
- Cable interference by nearby construction activity; and
- Insufficient capital for periodic general repairs.

The unavailability of circuits has affected users by making it difficult to:

- Implement new types of applications; and
- Operate low and, particularly, medium speed data transmission equipment.

Practically all the cable circuits are occupied and in need of emergency repairs. The aerial lines are generally very old with major repairs not executed on time or not executed at all. These lines become noisy when they get wet.

The Railway's interurban cable network consists of 6,506 km of underground copper cables. This cable extends along the main lines and branch lines of SNCFR throughout the entire country. The cross-section of copper pairs in the main toll areas is 38 with reduced amounts on branch lines. Every physical circuit on the copper pairs is used for dispatcher lines, telephone lines, data lines, and various other Railway telecommunications services. The urban cable network consists of 5,114 km of copper cable and is similarly filled to capacity. The aerial lines extend for 4,776 km. A new fiber optic cable network will supplement the existing interurban cable and aerial line facilities for approximately 3,597 km along the main lines of SNCFR. Those copper cable facilities paralleling the fiber optic

network will be used for back-up circuits and spare parts to keep the remainder of the main line and branch lines in operating condition. The aerial copper lines will be disassembled. A map in Figure 5-1 shows the remaining old analog copper cable and aerial line routes that will need to be used outside fiber optic cable territory in black and the fiber optic cable routes in red.

Fiber Optic Cable Network in the World Bank Project

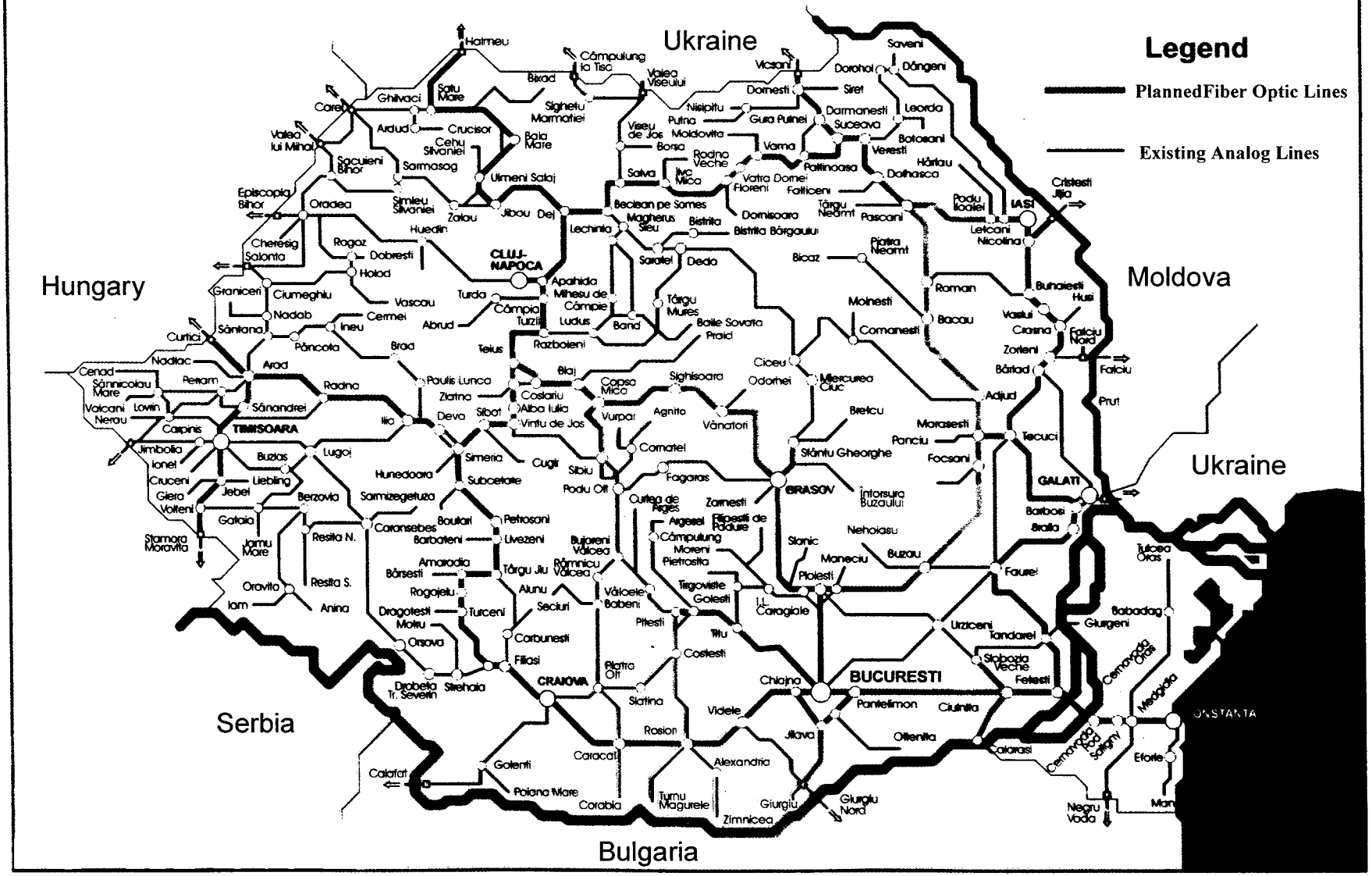
As shown in Figure 5-1, the optical fiber backbone network will be installed along the railway main lines. Some of the rail lines are double track, electrified with standardized 25 KV/50HZ power and equipped with relay interlocking and automatic block systems. Fiber optic cable is safe to use around high power lines, since it does not contain metal parts. It does not react to electrical or electromagnetic interference and therefore the circuits operating on this fiber system will have low error rates in the area of 10^{-10} errors per bit transmitted.

The aerial installation of fiber cable will comprise 64% of the fiber optic network and will be installed on the same concrete poles as the electrified section power lines. The remainder of the fiber network will be installed in ducts underground and in buildings. The 2,250 km of aerial installation will be in sections with enough slack so that should one tree fall across the cable taking it to the ground, there will be no damage to the cable. The cable has a coating on the outside that is bullet resistant and should protect in case it is used for target practice. The 1,255 km of underground installation will be installed in HDPE (High Density Poly Ethylene) permanent lubricated duct (40 mm diameter). The system will contain terminals and regenerator sites for termination of the fiber cable and installation of lightwave equipment. After an initial period dedicated to right-of-way civil engineering, optical link design and equipment engineering, the system installation will proceed. The cable will be installed by a Romanian contractor, which has not yet been chosen.

The optical fiber cable will contain a cross-section of twenty fibers. The Railway will retain approximately ten of these fibers for its own use and the other fibers will be used for external market applications.

The fibers utilized by the Railway can carry many times the initial circuit configuration if wavelength division multiplexing (WDM) is applied to the 1550 nm window and/or the 1310 nm window. Also, technology development has

Figure 5-1: PLANNED FIBER OPTIC LINES OF SNCFR



recently arrived at the point where STM-64 equipment is now available. Nortel in the U.S. is now suppling both STM-64 and the similar Sonet OC 192 equipment. STM-64 has four times the bandwidth of STM-16 equipment.

The fiber optic cable is of three different types depending upon deployment; aerial with 20 fibers in one tube, underground in a 6-6-6-2 configuration, or for interior installations in two separate 10-fiber tubes. The general characteristics of the fiber runs are:

- 20 Single mode fibers.
- Operating wavelengths at 1310 and 1550 nm.
- Central buffer tube design (dual layer).
- Buffer tube fully filled.
- Non metallic strength members over the core (7.2 mm^2).
- PE (Poly Ethylene) jacket.
- Fully Dielectric cable (i.e. no metallic parts).
- Aerial cable suitable for tension lengths up to 1500 meters
- Aerial cable suitable for span lengths of 150 meters between supports

The single mode fibers to be used are Siecor (SMF 1528 CPC6) in compliance with ITU-T Recommendation G. 652. The SMF 1528 CPC6 fibers are designed for operation around 1300 nm and meet additionally the present day requirements of improved performance around 1550 nm. The geometrical, optical and mechanical specifications surpass the relevant international, European, and national standards. The CPC6 coating is optimized for loose tube, slotted core, ribbon and tight buffer cable applications. The OVD (Outside Vapor Deposition) process is used in the making of the optical fiber. The fiber consists of a doped fused silica core with step index profile and a fused silica cladding (matched clad). It is protected by a

Composite Protective Coating. The CPC coating consists of two layers of UV-cured acrylate resin with a 245 μm nominal outside diameter. The general Siecor specifications of the fiber are:

- Fiber core: Ge-doped Silica only.
- Fiber cladding: Pure Silica only.
- Coating: CPC6 Type, double layer UV-cured acrylate.
- All fibers are completely phosphorus free.
- Attenuation Coefficient:

At 1310 nm	0.34 - 0.45 dB/km
At 1550 nm	0.19 - 0.25 dB/km

- Chromatic Dispersion:

At 1285 nm ≤ λ ≤ 1330 nm	≤ 3.5 ps/(nm.km)
At 1550 nm	≤ 18 ps/(nm.km)

SNCFR's actual specification required an attenuation coefficient of 0.36 dB/km at 1310 nm. The cable was tested before acceptance and averaged 0.335 dB/km at 1310 nm and 0.194 dB/km at 1550 nm. The tests also yielded values of ≤2.548 ps/(nm.km) in the 1285 to 1330 range and ≤16.497 ps/(nm.km) at 1550 nm for chromatic dispersion.

Recommended Fiber Optic Cable Network Extension

It is recommended that additional fiber optic routes and equipment be added to the ISDN system to complete its development. There are two reasons for these extensions: 1) to insure a more complete coverage for potential commercial use and 2) to provide a more complete system of "ring configurations" which will provide a higher level of security. Table 5-1 lists the recommended extensions and ring closures.

These system additions add 1,815 km of fiber optic cable routes to the fiber optic system. 1,088 km of the additions are intended to complete a system that will

Table 5-1: Recommended Network Extensions

Nbr.	Section Name	Length (Km)	Aerial/ Undrg'd
1	Rosiori - Alexandria	34	U
2	Caransebes - Resita	43	U
3	Jibou - Zalau	23	U
4	Bistrita - Saratel - Beclean pe Somes	36	A
5	Veresti - Leorda - Botosani	44	U
6	Becau - Piatra Neamt	60	U
7	Medgidia - Tulcea	144	U
8	Titu - Targoviste	32	U
9	Caransebes - Timisoara	98	A
10	Oradea - Satu Mare	133	U
11	Sibiu - Podul Olt - Ramnicu Valcea	176	U
12	Gura Motrului - Drobeta Turnu Severin	71	A
13	Sfantu Gheorghe - Miercurea Ciuc	63	A
14	Craiova - Piatra Olt - Slatina	61	U
15	Sighisoara - Targu Mures	70	U
	TOTAL ADDITIONAL BRANCHES	**1088**	
1	Cluj - Oradea	153	U
2	Targu Mures - Deda - Saratel	54+47	U+A
3	Constanta - Mangalia	43	U
4	Ciceu - Adjud	150	A
5	Pitesti - Slatina	81	U
6	Ramnicu Valcea - Piatra Olt	87	U
7	Drobeta Turnu Severin - Caransebes	112	A
	TOTAL ADDITIONAL RING CLOSURES	**727**	

reach all of Romania's counties thus providing a more commercially attractive system. The remaining 727 km will form additional ring closures improving the security and performance of the communications system. The resultant system will be 87% secured by ring configurations. Figure 5-2 presents a map of the planned system including the recommended extensions.

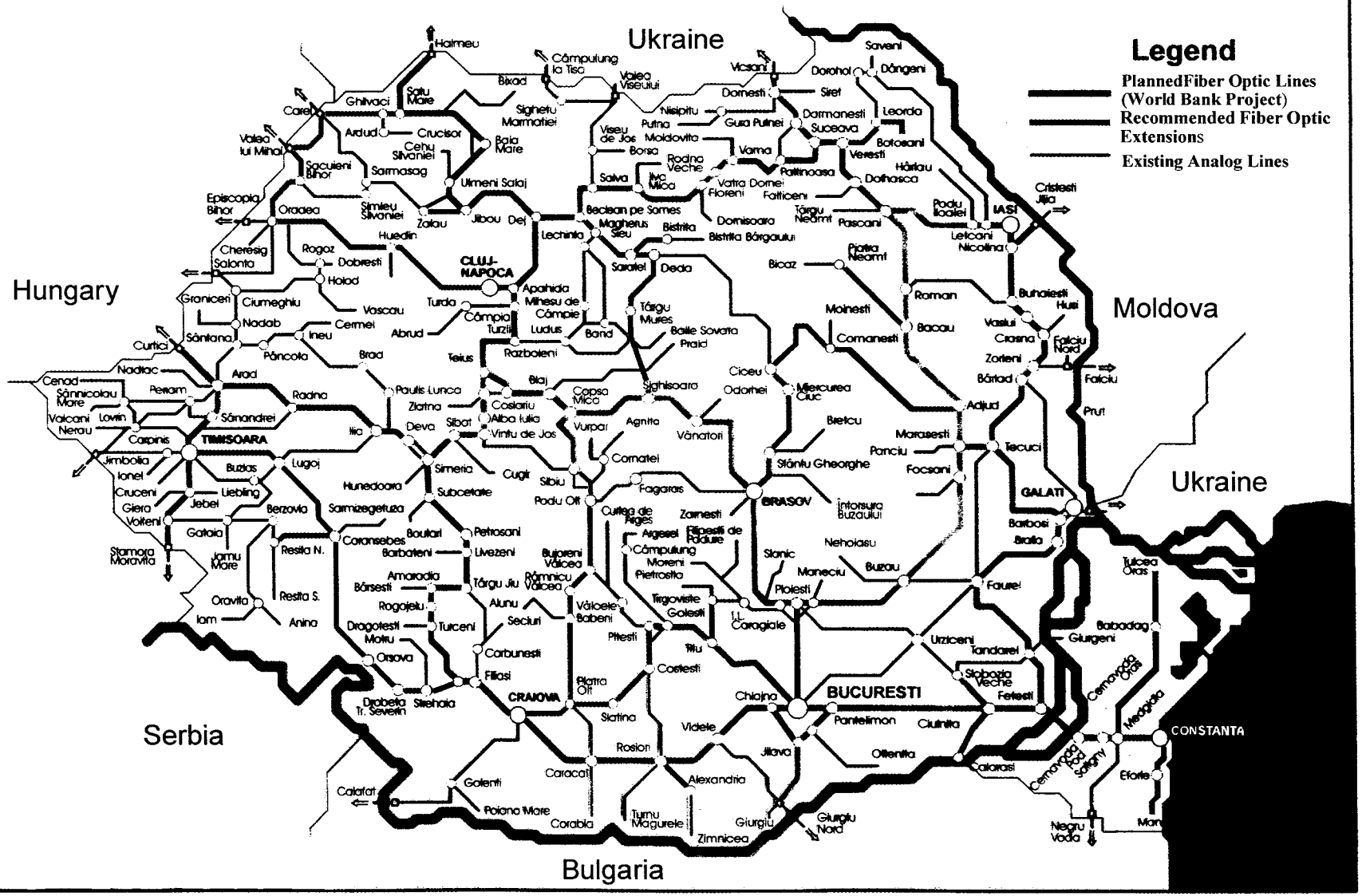
When fiber cable cuts or major transmission equipment failures occur on branch lines, the far end of the branch line is isolated from the rest of the transmission system for the time it takes to repair the problem. These cable cuts or equipment failures that cause considerable disruptions on branch lines would have "self-healing" properties if similar failures occur on fiber optic ring configurations. The "self-healing" properties of the fiber optic ring configuration is equivalent to having backup circuit facilities available when the regular circuit facilities are not operational. The proposed telecommunications system with ring configurations will be better able to meet the requirements of the external market.

Recent Developments in Fiber Technology

Siecor single mode fiber (SMF 1528 CPC6) is a standard fiber designed for operation at the 1310 nm window and capable of improved performance at the 1550 nm window. The distance between terminals and/or regenerators using this fiber is controlled by the attenuation coefficient at the 1310 nm window and the chromatic dispersion at the 1550 nm window. WDM (wavelength division multiplexing) can be used to operate simultaneously in the 1310 nm and the 1550 nm windows on the same fiber. However, the distance between optical transmitters and receivers must be compromised so both windows can operate properly.

The 1550 nm window has a low attenuation coefficient and a high dispersion index. The fiber manufacturers have been producing dispersion shifted optical fiber for a few years now to take advantage of the low attenuation in the 1550 nm window. This allows greater distances between terminals and/or regenerators.

Figure 5-2: PLANNED AND RECOMMENDED FIBER OPTIC LINES OF SNCFR



SNCFR is aware of the developments going on within the fiber optic technology. During the current construction cycle, SNCFR is testing each fiber run as it is installed and applying FC-APC connectors to the four fibers with the least dispersion with the intention of increasing the system speed to STM-16 when future capacity increases are required. The remaining 16 fibers will use FC-PC connectors.

It is suggested that additions to the STM-16 system (or even the coming development of STM-64 systems) in the existing fiber cable being installed may require additional engineering. Two possible approaches are: 1) to add regenerators to the upgraded line or 2) to install spools of negative dispersion cable at the transmitting and receiving locations to balance the dispersion to a workable level on the positive side of zero.

Considerable research is going on with optical fibers. Optical fiber producing companies are trying to optimize the number of systems that can be carried on a single fiber pair. They are shifting the dispersion of the fiber away from the 1528 to 1565 nm window resulting in a positive 3ps/nm-km or a negative 3ps/nm-km of dispersion. However, the dispersion curve must not pass through zero within the above 1528 to 1565 nm window, according to recent research results. Dispersion rates of zero make the fiber unusable due to excessive errors. In this window, eight OC 192 Sonet systems (the U.S. counterpart to STM-64 type equipment) of 10 gigabits each are being installed with WDM in the United States. If additional fiber cable is to be installed by SNCFR, dispersion shifted fiber should be considered.

D. TRANSMISSION SYSTEMS

Existing Transmission System Installed on Copper Cable

The existing multiplex transmission system is an old analog network that is 100% occupied with operational channels. The original equipment manufacturers have stopped their support of this type of transmission equipment. To keep this system operational, SNCFR Telecom repairs old parts and reuses them and/or does whatever is necessary to keep as many transmission channels in service as possible. These twelve channel transmission systems operate over copper cable pairs with regenerators where required. The toll areas have 7 or 8 cable multiplexes each with a capacity cross-section greater than 127 vocal circuits. The number of systems on branch line cables is reduced according to traffic requirements.

The telex carrier systems operate on the vocal channels and provide low speed (50 baud) data circuits for transmitting messages throughout the Railway network. The transmission equipment and teletypewriters comprising this system are worn out and will be replaced by a state of the art computer-based system. A new digital transmission network will supplement the existing cable carrier networks for 3,597 km. The cable carrier networks paralleling the new digital transmission network will be used for backup circuits and spare parts to keep the remainder of the main line and branch line carrier systems in operating condition. A map shown in Figure 5-3 shows the digital transmission network and its rings in color and the additional main line and branch line copper cable carrier network and aerial lines in black.

The Digital Transmission Network in the World Bank Project

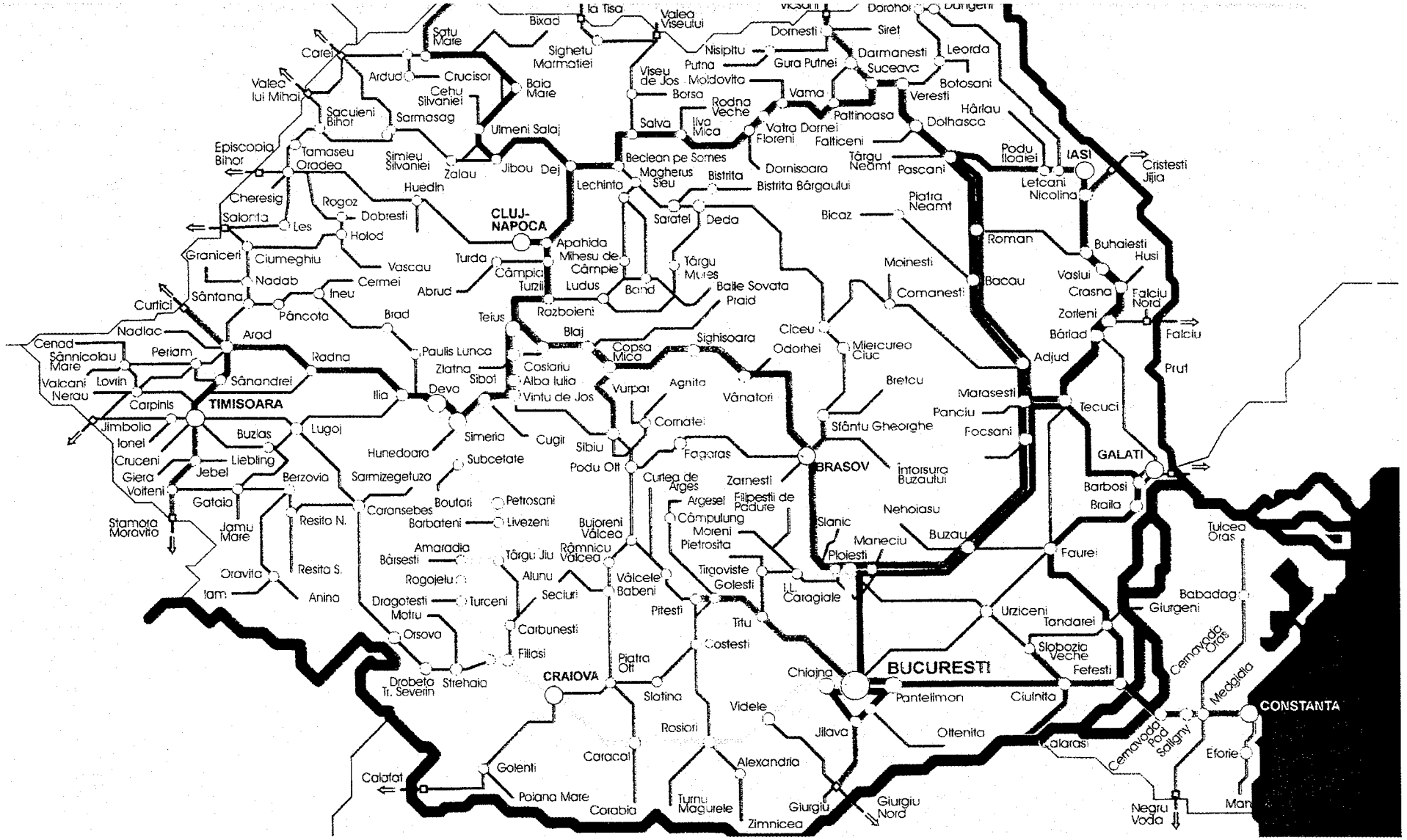
The optical fiber backbone transmission network will interconnect the Railway's eight Regional Headquarters with the Administration Center in Bucharest. The network will be made up of four interconnected rings, one metropolitan ring (in Bucharest), four local rings, four main branches, seven minor branches, four appendages, fifteen local point-to-point SDH (Synchronous Digital Hierarchy) links and several local point-to-point 2 Mbps links. Given that the recommended six additional fiber optic rings described in the previous section are installed, the rings will be connected to each adjacent ring at two locations and would be "self-healing" in case of a fiber cable cut or equipment failure. The 60 km section of fiber cable between Bucharest and Ploiesti is already installed and operational.

The synchronization of the SDH network of SNCFR will be of high quality to run the switching and data transmission networks. The transmission network will use a synchronization architecture based on GPS. An external clock is necessary and is being procured for the SDH network elements to derive transmission timing, and therefore, transmit synchronously.

As illustrated in Figure 5-3, the digital transmission network of SNCFR will have a Network Management Center (NMC) in Bucharest and two Regional Management Centers (RMC) located in Cluj and Iasi. The NMC center will be staffed 24 hours a day to handle transmission system problems. The RMC centers will be staffed as required to handle the regional network problems.

Both SDH and access transmission equipment will provide a range of facilities including drop/insert and cross-connect of standard PDH and SDH hierarchy

Figure 5-3: SNCFR's PLANNED DIGITAL TRANSMISSION NETWORK



tributaries and drop/insert at the 64 kbps channel level. The SDH network will also serve as a video distribution media by employing video-codec interfaces.

SDH network availability for tributaries and higher will be better than 99.995%. The mean time between failures (MTBF) for each plug-in unit of SDH equipment will be at least 35 years and of any SDH network element will exceed 3 years. The transmission equipment (SDH and PCM) will have an operational lifetime of at least 15 years.

After system installation, which will include the placement of fiber cable in aerial supports and /or underground conduit, the construction of terminal and regenerator sites and the construction of the NMC/RMC sites, the placement and interconnection of optical components will follow. The electronic equipment will then be tested on a per-site and link basis as the equipment is installed to verify proper operation. System testing and end-to-end performance testing will be undertaken prior to commissioning. The configuration of the fiber optic system will be based on the performance of the fiber optic equipment. The planned equipment spacing of 60 km by SNCFR is appropriate for the type of fiber being installed. The definitive locations of regenerators, however, will be dependent upon terrain, accessibility, availability of power, and distance restrictions imposed by the fiber optic equipment.

Recommended Digital Transmission Network Extension

The recommended digital transmission network would be applied to the 1,815 km of fiber optic cable extensions. These extensions should be nominally outfitted to operate at STM-1. However, consideration should be given in the construction and materials details on selected routes for upgrading to STM-4 in the event that large future increases in communications traffic are encountered.

The cable sections to which digital transmission equipment would be applied are the same as those in Table 5-1 on page 101. The improved ring configuration resulting from the recommended extensions adds substantially to the security and commercial value of the system. In regards to the transmission system, each ring network needs to be interconnected to each adjacent ring by multiplex equipment at two locations to avoid outages in case one interconnection location is lost.

Emerging Digital Transmission Technology

The Synchronous Digital Hierarchy (SDH) is an independent fiber optic based transport vehicle that establishes a wideband transmission technology for worldwide telecommunications networks. The ITU-T has developed SDH as a single international standard to provide for the fiber interconnection of the telephone networks of different countries. SDH can be used with the same ease as the present telephone network system; however, its increased configuration flexibility and bandwidth availability provide significant advantages over the current system. These include:

- The ability to multiplex voice, data and video signals into a broadband synchronous channel, within which individual bytes can be easily and uniquely identified.
- A reduction in equipment requirements and an increase in network reliability.
- The provision of overhead and payload bytes with the overhead bytes permitting management of the payload bytes on an individual basis.
- The definition of a synchronous multiplexing format for carrying lower level digital signals (such as CEPT 2.048 Mbps and CEPT 140 Mbps) and a synchronous structure, which greatly simplifies the interface to digital switches, digital cross-connect switches, and add-drop multiplexers.
- The availability of a set of generic standards, which enable products from different vendors to be connected with ease.
- The definition of a flexible architecture capable of accommodating future applications, such as broadband Integrated Service Digital Network (ISDN) with a variety of transmission rates.

SDH defines a standard for carrying many signals of different capacities through a synchronous, flexible, optical hierarchy. This is accomplished by means of a byte interleaved multiplexing scheme. It eliminates several layers of multiplexing, and offers end-to-end network management. The first step in the SDH multiplexing process involves the generation of the lowest level or base signal. The ITU-T nomenclature refers to signals as Synchronous Transport Modules (STM-*N*). STM-*N* signals are multiples of 155.52 Mbps. An STM-*N* signal is composed of *N* byte-interleaved STM-1 signals. These bit rates are defined as:

ITU-T	DATA RATE (Mbps)
STM-1	155.52
STM-4	622.08
STM-16	2488.32

SDH utilizes a byte interleaving technique which makes all bits in a particular byte of data part of a single conversation. The advantage of the byte interleaving scheme is that channels, or conversations, may be added or dropped at each node of the network without de-multiplexing all signals down to 2.048 Mbps.

Unlike conventional data transmission schemes which use the bit stream itself to derive transmission timing, SDH network elements derive their transmission timing from an external clock. In other words, conventional systems transmit asynchronously, SDH transmits synchronously. Asynchronous timing systems require buffers large enough for entire frames of information - several hundred bytes in order to multiplex incoming signals. This introduces significant delays in the system. The SDH synchronous system, on the other hand, requires only a few bytes of buffering to account for small differences in timing. Consequently, only negligible delays are introduced.

SDH will provide the structure for broadband telecommunications of the future. When Broadband ISDN is perfected, it will permit not only voice transmissions to be transmitted at high data rates in digital format, but also high speed transmissions of computer data and TV/video signals. For example, FDDI (Fiber Distributed Data Interface) allows interfacing with LANs (Local Area Networks) for efficient transmission of data at 100 to 125 Mbps. Such a signal will map directly into an STM-1 frame. Furthermore, an STM-1 signal can contain 4 signals @ 34.368 Mbps (CEPT) each or 3 North American hierarchy DS-3 signals @ 44.736 Mbps. Each STM-1 signal will carry three or more standard NTSC TV signals or one compressed HDTV (High Definition TV) signal.

Circuit-level failure is minimized with back-up common systems and with "protection" and "working" channels operating on the switch system of the fiber network. This results in a typical system Bit Error Rate (BER) of 1×10^{-11} and a typical end-to-end system availability of 99.999% or better.

E. SWITCHING SYSTEM

Existing Private Automatic Branch Exchanges

The existing automatic telephone network switching equipment is out of date. The equipment consists of a large number of moving parts and has not been manufactured since 1972. The switching network has insufficient capacity for future applications and is worn out and needs replacing. There are 176 telephone exchanges with an equipped capacity for 33,201 subscriber lines and an existing utilization of 26,387 subscribers. These switches could support more than 6,800 additional subscribers if interurban trunk lines were available. The switch network is now supported by 6,181 trunk lines. The value of the total traffic per subscriber is an average of 0.17 erlangs (busy hour traffic). This means the 6,181 lines should handle the busy hour traffic with an acceptable call-blocking factor of 1%. However, the subscribers get through only about 40-60% of the time mainly because of the following reasons:

- Difficulty in establishing connections, especially interurban ones.
- Frequent interruption of already established connections.
- Unfinished connections, reverse busy tone, or busy tone.
- Wrong number connections.
- Difficulty of exiting to the PTT public network.

These problems can be caused by the switches (centrals) or the transmission system (centrals interconnection network). The main problems with the centrals are:

- Excess wear from long use (over 50% of the centrals exceed their designed life cycle).
- Lack of spare parts (the production of Basa type centrals was discontinued 25 years ago).
- No means of increasing physical switch capacity.
- Excess wear because of unfinished and repeated calls.

The main problem with the transmission system is the limited number of intercentral circuits and intercentral junctions. The majority of the existing switching system operates with 112 obsolete electro-mechanical step-by-step type Basa switches which are badly in need of replacement. The World Bank upgrade will replace 149 switches of Basa and other types out of the 176 existing automatic switches leaving 27 non-digital switches in service. Some of the replaced equipment will be used for spare parts to maintain the 27 older switches remaining in service. A map in Figure 5-4 shows in color the locations of the new international, transit, and nodal switches along with the new integrated services network. The local switches served by the nodal centers are not shown.

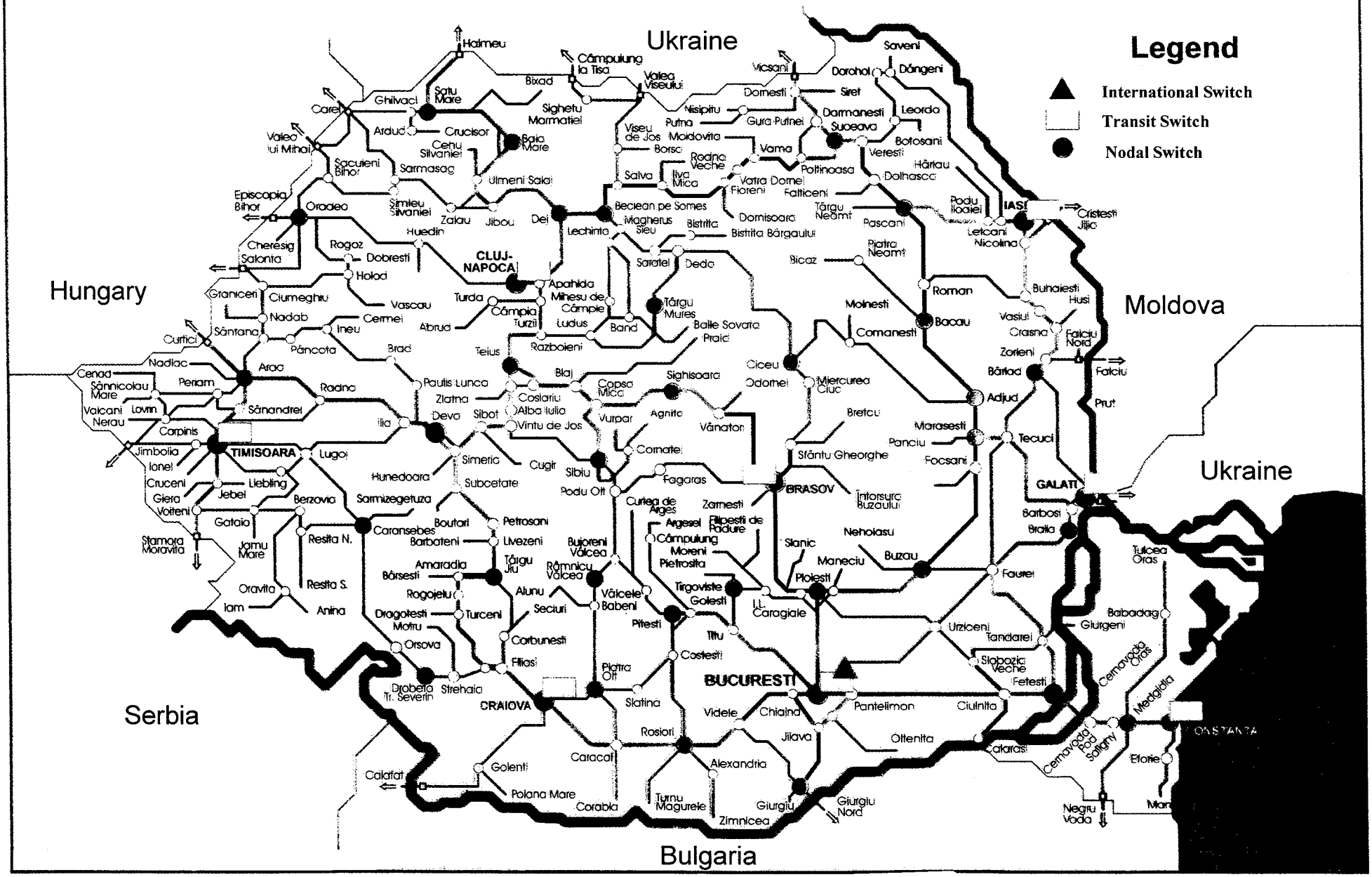
Switching Network with Integrated Services in the World Bank Project

As shown in Figure 5-4, SNCFR will be installing a new digital switching system to replace the majority of the old step-by-step type switching equipment. These switches will be placed on the new 3,597 km of fiber optic facilities and on an existing analog medium of 7,800 km. The switched network will interconnect with a digital transmission network and the existing analog transmission network. Two service levels will be offered:

- Digital services between two users both on digital mediums.
- Exclusive voice service, if one or both users are on the analog medium.

At the digital level, the switching network will integrate voice, data and video communications, introducing multiple services that are accessible from any digital point and incorporating management functions (supervisory and administration).

Figure 5-4: PLANNED DIGITAL SWITCHING SYSTEM OF SNCFR



The Railway's integrated telecommunications network will be interconnected with other public networks. The principal characteristics of the future railway telecommunications network will be:

- A digital network including all integrated railway telecommunications services.
- Compliant with ITU-T and ETSI recommendations for hardware and software.
- Adaptable, flexible, reconfigurable and modular (expandable) components.

The integrated network will be used by the Railway employees, clients of SNCFR transport services, and other non-railway users whose activities are connected to SNCFR operations.

The users will be able to use the following terminal equipment types:

- Analog telephone sets.
- Digital telephone sets.
- ISDN telephone terminals.
- Telefax terminals.
- Videotext terminals.
- Data terminals.
- PC personal computers.

The network will be capable of:

- Voice, data and video communications;
- Special services including value added; and
- Supporting specific railway applications.

The existing automatic telephony sub-networks, and a part of the data transmission functions will be supported by the new digital switching network. The IRIS data network, currently under development, will operate over the new digital switching

network. The older, existing X.25 data network will generally continue to operate at slower speeds in an analog environment over the older copper infrastructure. The three data networks, ISDN, IRIS and X.25 will be interconnected. The ISDN network will exit onto the older copper infrastructure at *N* x 64 kbps where fiber optic routes are not available.

The integrated services network will offer the following set of services:

- Standard services (telephony, telefax, etc.)
- Data transmission services (with circuit switching).
- Video services (videotelephony and videoconferencing).
- Value added services (voice mail, GSM, file transfer, paging, E-Mail).

Voice connections will occur between two telephone sets of any kind, two analog fax terminals of any kind, and the telephone sets or the telefaxes can be part of two different networks.

Data connections will occur between a PC terminal and:

- Another terminal or PC.
- A main computer (host).
- A LAN (Local Area Network).
- Peripheral equipment.
- Other data networks and between two LAN networks.

Video connections will be able to occur between two videophones and two or more videoconferencing terminals.

The tender document for this equipment has not been completed and will not be public until the end of Autumn 1998. The number of switches to purchase under

this tender is still under consideration. The local switches will be 50% larger than the ones they are replacing.

Recommended Replacement of Residual Switching Equipment

There will be 27 older switches of various types in operation after the World Bank digital switch upgrade is completed. These switches need to be replaced with digital switches. This change would make the network all digital.

F. NETWORK INTERCONNECTION

In addition to its internal interconnectability, the SNCFR telecommunications system will interconnect to various external systems. Connections can be provided to public and private telephone networks, to international carriers, and to neighboring railways.

Where fiber optic trunks are available, connections will be made using SDH or PDH tributaries. Fiber optic connections at STM-1 are anticipated at the main points of connection to Rom Telecom. Fiber optic connections at STM-1 are also expected at border crossings to neighboring railways.

Where fiber optic trunks are not available, connections will use HDSL (High Bit Rate Digital Subscriber Loop) equipment. The HDSL equipment will be used to provide inter-exchange trunks primary rate access for ISDN, usually at 2 Mbps.

At some locations where distances are short, and infrastructure is inadequate, digital microwave at 17 Ghz and 2 Mbps up to 155 Mbps will be considered. This solution will be sought where it is economically attractive.

The HDSL system is designed to operate on unconditioned unloaded twisted pair cables. The system will operate either as a 2-pair or a 1-pair system. If the HDSL system is operated on a single pair, the operating bit rate will be N x 64 Kbps to 1,024 Kbps. Operation on two pairs will give a bit rate of 2,048 Kbps. The 2 Mbps HDSL systems may be deployed as terminals in point-to-point links. To expand the range of the terminal equipment, the system can use up to two regenerators in a transmission chain. The regenerators can be powered either locally or remotely. The HDSL equipment can operate for up to 11 km (terminal to terminal) and up to 33 km in a chain with two regenerators.

The HDSL system allows the Railway an efficient and appropriate means to serve the interconnection needs of its internal and external subscribers where fiber optic or other wideband transmission means are not available.

SECTION 6:
MANAGEMENT ISSUES

A. INTRODUCTION

In this Section, we review the management issues associated with SNCFR's entry into a competitive telecommunications market. Discussion of these issues is divided into four parts:

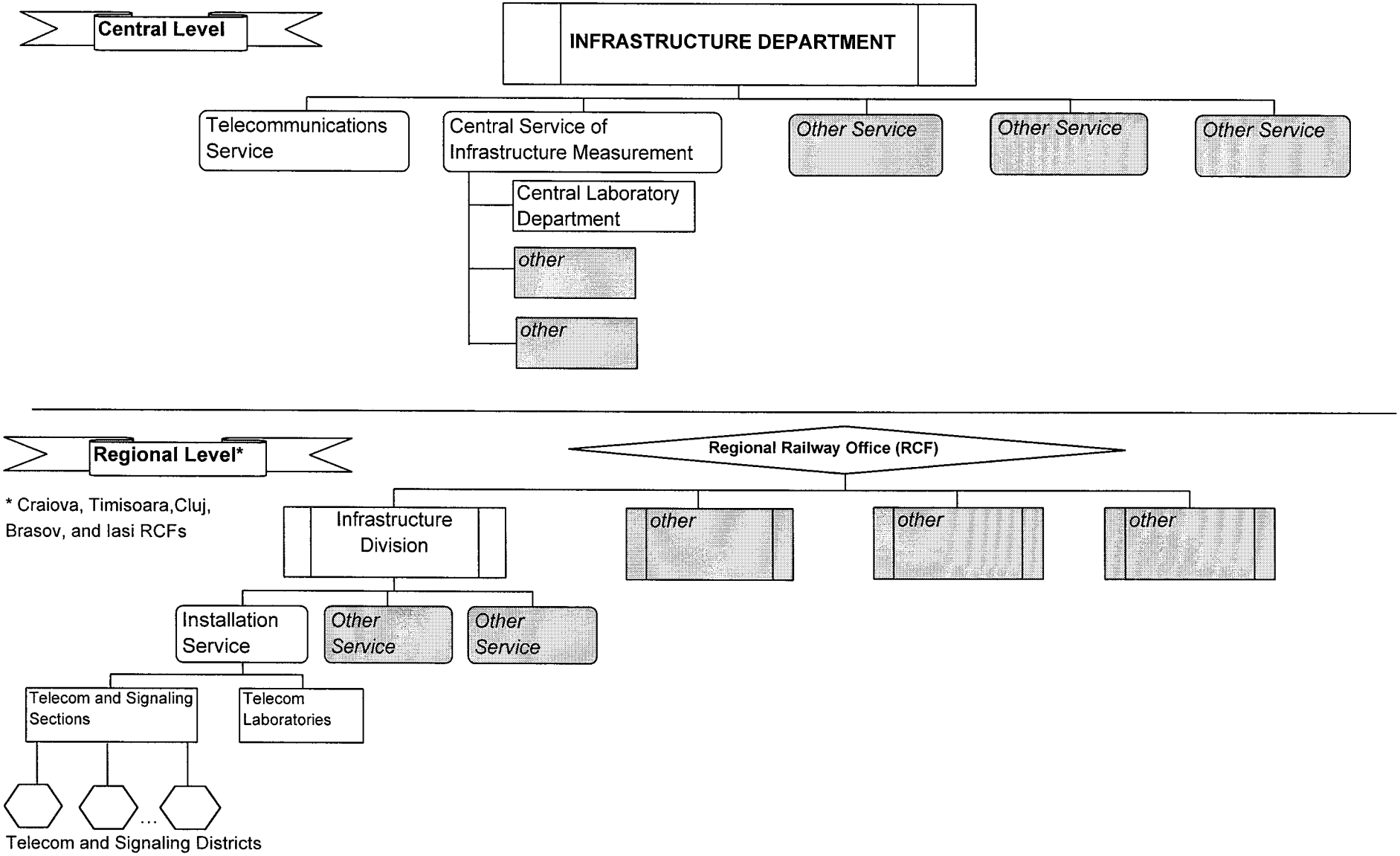
- Part B describes the present and evolving organizational structure of SNCFR's telecommunications function.
- Part C discusses specific operational and management issues, including staffing levels, staffing skills, and compatibility of serving SNCFR's internal telecommunications needs and, at the same time, becoming a commercial provider of telecommunications services.
- Part D presents a proposed general organizational approach for a new SNCFR telecommunications entity (ATCFR) to serve the Railway's internal telecommunications requirements and to compete effectively in a commercial environment.
- Part E summarizes our findings and conclusions.

B. SNCFR'S TELECOMMUNICATIONS STRUCTURE

Organization of Telecommunications within the Railway

As illustrated in Figure 6-1, the activity of railway telecommunications, at the central level of SNCFR, takes place within the Railway's Department of Infrastructure. Within that Department, most of the telecommunications functions are centered at the "Telecommunication Service". A certain amount of telecom-related activities also occur within the Central Laboratory Department of the Central Service of Infrastructure Measurements. This unit oversees the

Figure 6-1: EXISTING STRUCTURE OF TELECOMMUNICATIONS WITHIN SNCFR



telecommunication laboratories that are responsible for testing, measurement, and some repair of telecommunications-related equipment.

At the regional level, the Railway's regional offices (RCFs) have telecommunications units that operate within the Regional TTR (Telecom, Telegraph, & Radio) Laboratories and also within the Installation Services of the Infrastructure Divisions. Certain RCFs have a special sub-unit level where telecommunications activities occur in CT (Compartments of Telecommunications) sections. For example, at RCF Constanta and Galati, there are specialized telecommunication sections that are specifically involved in the Railway's telecom activities for the region. At RCF Bucharest, there operates a special unit "CT3 Section Bucharest", which performs maintenance of telecommunication installations in SNCFR buildings of RCF Bucharest, and installations in other parts of the region' s territory. With these exceptions, illustrated in Figure 6-2, telecommunications do not generally operate in specialized units, but as part of other activities.

Overall, within the present organization of SNCFR, telecommunications is one of several activities in the Infrastructure Department. In the past, priority for resources were focused on those activities directly responsible for the safety of circulation such as signaling (SCB installations) and traction power activities (IFTE-EA). While telecommunications was deemed to be important, it did not receive the same degree of funding or management attention as these two circulation-related functions.

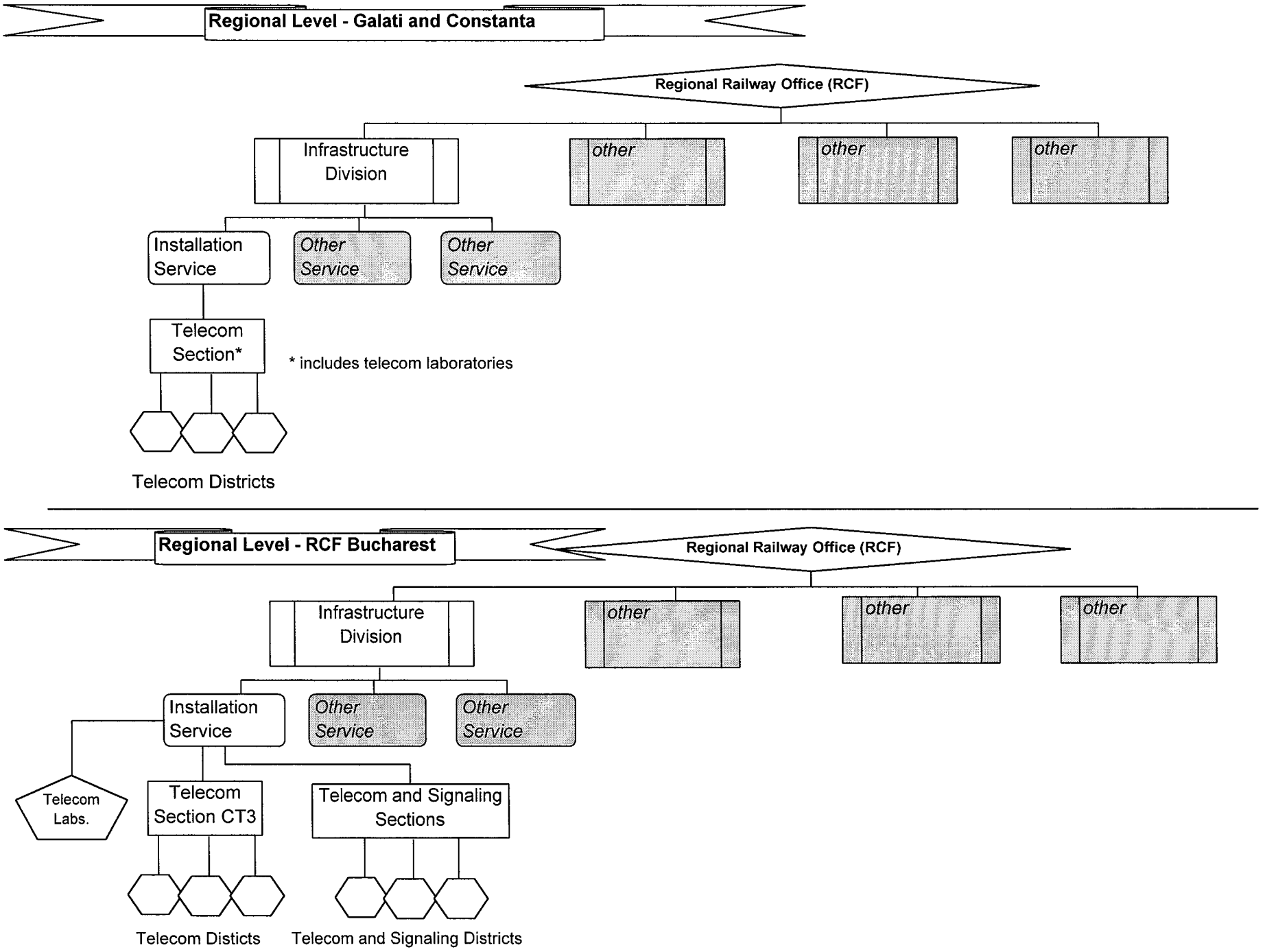
Railway Reorganization and Privatization

Recently, SNCFR has been reorganized into five separate companies.[4] They will be organized on free market, for-profit principles. The five organizations are as follows:

- *Compania Naţională de Căi Ferate* - **CFR (Infrastructure)**: which will be responsible for administering the railway's infrastructure, including

[4] The reorganization of SNCFR was formally announced by the Romanian Government in its official publication *Monitorul Oficial al României*, in the Partea I, 8 July, 1998 edition, under Title II.

Figure 6-2: Regional Level - RCFs Galati, Constanta, and Bucharest



telecommunications activities, and additional railway patrimony.

- *Societatea Națională de Transport Feroviar de Marfă* - **CFR Freight**: which will be responsible for the Railway's freight transport activities.

- *Societatea Națională de Transport Feroviar de Călători* - **CFR Passenger**: which will be responsible for the Railway's passenger transport activities.

- *Societatea de Servicii de Management Feroviar* - **The Society of Railway Management Services - SMF**: which will have responsibility for financial - accounting services, administration of external credits, and general management of business services for the overall Railway.

- *Societatea de Administrare Active Feroviare* - **The Society for Administration of Railway Activities - SAAF**: which is a temporary organization to administer the properties and activities not readily divided into the other operating companies.

In light of SNCFR's interest in entering the commercial telecommunications market, the restructuring provides an ideal first step for implementing the organizational changes required to best operate in and benefit from this potentially profitable market.

C. SPECIFIC OPERATIONAL AND MANAGEMENT ISSUES

Rail / Telecommunications Compatibility

As is well known, the basic concept of telecommunications is the exchange of information over relatively large distances and between separate locations. The information may include voice, text, data, and image. Therefore, a telecommunications network is largely a system that can provide these services to a number of end users. In the commercial business variant, the telecommunications

provider plans, installs, runs and maintains such a network so that end users are able to connect to the network and enjoy these services by paying for them.

To transform a telecommunications operation into a viable business requires, in part, large capital assets, land, lines, equipment, and technicians - it needs an infrastructure. The railway can provide such infrastructure. It has its own rights of way, internal telecommunications system, extensive nationwide rail network, the personnel to maintain lines and equipment, and the expertise to make it run. On the other hand, an effective commercial telecommunications operator can benefit the railway by providing efficient delivery of high quality voice and data transmission services, important for the operation of a modern railway. Given the mutual benefits, there is a natural partnership of railway and commercial telecommunications operator.

With the completion and operation of its fiber optic network, SNCFR will have a modern, high-capacity system for telecommunications services. Its network will have more than sufficient capacity to meet all of its internal needs. Under these circumstances, it is natural for the Railway to have an interest in exploring the opportunities of the external telecommunications market. SNCFR's vast track network, regional structure, and trained personnel provide an ideal framework for pursuing such commercial telecommunications objectives.

Thus, it is in the best interest of the Railway to organize its telecommunications activities to take advantage of this opportunity. The more that telecommunications can be organized into a unified, cohesive structure, the better that it will be able to utilize its resources and control the quality of its services. ***An efficient, effective Railway Telecommunications Agency not only will provide the high quality services required by the internal demands of the Railway, but will also provide the performance necessary to generate profits from the external market.***

Staffing Issues

To compete effectively in a telecommunications market, SNCFR must address the key issue of staffing. What is the relevant experience of SNCFR and its personnel in the telecommunications field? From a technical perspective, SNCFR's approximately 2,900 telecom personnel have the necessary experience for managing a telecommunications network. Their skills and experience, however, are geared toward the service and operation of the Railway's old analog facilities. Most of these existing analog-related facilities are outdated, and their spare parts

are difficult to obtain. Keeping these facilities operational requires a great deal of repair work on old parts. Therefore, this heavy maintenance effort resulted in a large maintenance work force.

With the installation of a new state-of-the art fiber optic transmission system and digital switches, the maintenance requirement will be reduced and consist mainly of preventive maintenance. This means that fewer personnel will be needed to operate and maintain the new system. The skill level of the personnel will need to be increased, however, to meet the requirements of the new digital equipment. Fortunately, the World Bank credit provides funds for training of personnel for the needs of the new equipment. The equipment suppliers will be providing this training initially, and will likely be reinforced by internal Railway training activities as well.

In the commercial telecommunications market, there is a trend towards service-oriented rather than technology oriented structures. Another way of expressing this trend is to say that telecommunications operators are now obliged to be customer-oriented to be competitive. It is in the commercial aspects of a telecommunications enterprise - marketing, customer service, billing, and financial matters - that SNCFR needs to be strengthened.

The reorganization of SNCFR will provide opportunities to redistribute Railway personnel more efficiently. To the extent that telecommunications operations become organized into a more unified and cohesive entity, resources and staff will be more efficiently utilized. Specific staffing requirements will be influenced by several factors:

- scale of operations
- business strategy
- extent of entry into the market
- organizational priorities
- financial considerations

SNCFR appears to have excessive personnel if it is to be viable as a commercial telecommunications operation. Table 6-1 provides a comparative overview of telecommunications staffing for selected countries. This information is based on staffing levels for national telecommunications organizations, which are on a larger scale than SNCFR's telecommunications activities. Taken at the per unit level (lines per employee), however, the data is useful for illustrating the average productivity levels for Eastern Europe and for other countries.

As is illustrated in Table 6-1, SNCFR's 18 main telephone lines per telecommunications employee does not compare favorably to the others. Certainly, the scale of operations affects the statistic, and the special staffing requirements of conducting telecommunications for a railway also must be considered. Yet, if SNCFR is to participate successfully in the commercial telecommunications market, it must focus on bringing its productivity more in line with its potential competitors. Its organization must be streamlined to be competitive and to provide improved telecommunications services. These services will be demanded by the business user who is fundamentally interested in the availability, cost, and efficiency of these services. More specifically, the business user will demand:

- services which can promote his own business;
- high quality services;
- fast and easy access to services; and
- low cost for services.

In general, if a network provider can manage to provide new high quality services on demand at low cost, he is likely to be selected as the business's service provider. If, as a service provider, he can offer and sell attractive services early, i.e., before competition reduces the price, his gross income should increase. If he can implement required services at low cost, his net income should also increase. Then, if the provider can sustain this activity, he becomes successful and viable.

Table 6-1: Telecommunications Staff for Selected Countries in 1996

Country	Main Lines per Employee
Bulgaria	100
Czech Republic	104
Greece	224
Hungary	164
Poland	89
Romania	**59**
Russia	58
Slovak Republic	79
Turkey	194
Ukraine	71
United States	190
Japan	289
Germany	205
SNCFR*	**18**

Source: International Telecommunication Union, ***World Telecommunication Development Report 1998.*** Geneva, Switzerland; March 1998: World Telecommunication Indicators. pp A61- A63.
* SNCFR figure based on 1998 figures of 33,000 lines and 1,820 of its 2,900 telecom employees.

The current seller's market in the telecommunications service industry is likely to change radically in the near future, and, thus, there is an important message to all participants, in particular to the network operators: "Achieve excellence or fail." Overstaffed, inefficient organizations will not attain the "excellence" required to be successful in the commercial telecommunications market.

There are several necessary prerequisites to achieving excellence, but among them is an effective, lean organization that is staffed with skilled, experienced, and well-motivated employees.

D. PROPOSED ORGANIZATIONAL APPROACH FOR A COMPETITIVE TELECOMMUNICATIONS MARKET

The most successful organizations are those that are able to continuously adapt their structure, working procedures, and tools to best meet the challenges of their changing environment. Those that are best able to adapt to the needs of the market are better positioned to operate within it. Therefore, there is no single universal model for the structure of a telecommunications organization. Each company must arrange its activities based on its specific commercial objectives and operating circumstances.

In the case of SNCFR, if it is to operate successfully in a competitive telecommunications market, it must be ready to transform its structure in a manner that will not only best serve its own needs but also the needs of the market. In Section 8, TERA identifies alternative business strategies and offers recommendations on which of them may be most suitable for the Railway. In this part of Section 6, we describe a general organizational model which SNCFR's telecommunication agency can adapt and modify in accordance with the business strategy it selects.

A General Organizational Model

The proposed organizational model is based on certain assumptions, key among them is that telecommunication services should be integrated into a single entity. This conforms to the principle of reorganizing the Railway into separate operating companies based on their functional activity so as to utilize existing resources more efficiently and to more effectively operate in a free market. Until joint venture partners are sought, as TERA recommends for active commercial activities, it is not necessary to make telecommunications a separate operating company. It should at least, however, operate as a division of the CFR Infrastructure Company, to retain better control of its activities and, hence, to be able to deliver more efficient services to its customers. For reference purposes, this new agency may be named the CFR Telecommunications Agency or ATCFR.

Other assumptions of this model are:

- ATCFR will be open to joint venture possibilities in the future. Hence, it should be organized to potentially become an independent, joint venture company (JVCo).

- At some point, ATCFR, or as we have proposed its joint venture form - JVCo, will be active in the external telecommunications market, and, at the minimum, it will provide "backbone" telecommunication services to commercial entities (2 Mbps access).

- ATCFR will continue to provide telecommunications services to the other SNCFR companies and departments.

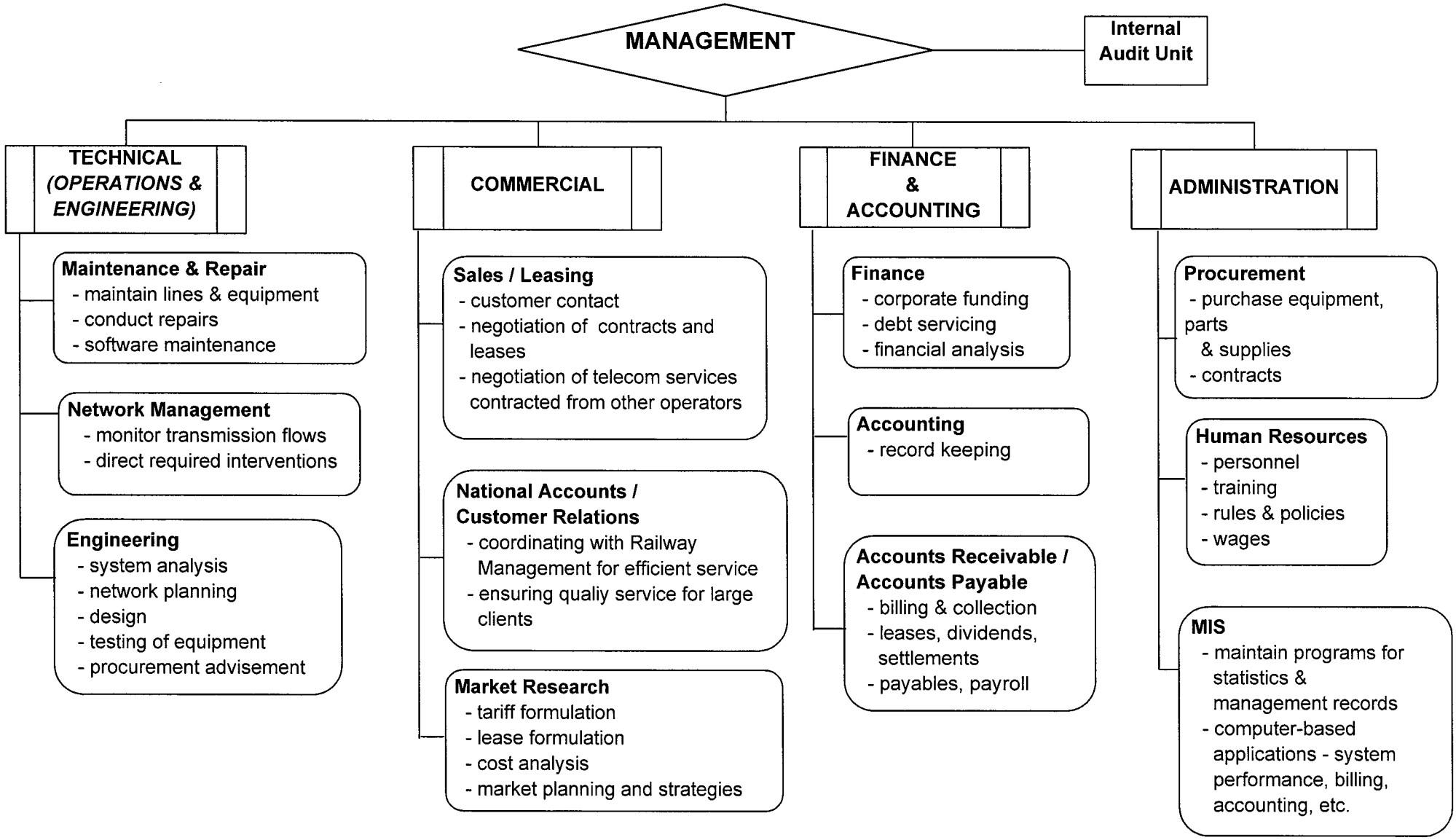
As illustrated in Figure 6-3, ATCFR would be organized, at the central corporate level, into four departments: Technical, Commercial, Finance & Accounting, and Administration. Each department would be structured along the following lines:

Technical Department. The Technical Department is conceived as a combination of a traditional Operations Department and an Engineering Department. Regardless of the business strategy, an operator's ability to deliver telecommunications services is dependent on its technical competence. Because of its significance, a large bulk of the organization will reside in this department. It will have responsibility over the telecommunications assets of the company and the personnel who are responsible for maintaining and operating them. Its purpose is to maintain, manage, and develop the telecommunications network of the company. These functions are performed by three sections:

Maintenance & Repair. This is essentially the "muscles" of the department. It is responsible for ensuring that the telecommunications lines and equipment are maintained, needed repairs are performed, and equipment and software are functioning properly. It will coordinate a staff that will consist largely of traditional telecom skills, but with a component of trained new personnel for handling the digital equipment. A portion of the digital staff will be obtained by training and utilizing the experience of selected SNCFR telecommunications personnel.

Network Management. This section can be compared to the "eyes and nerves" of the network. Its responsibility is to monitor the status of the network and its transmissions. System managers can re-route the system flows and direct the needed interventions on the system to ensure that it is operating properly and efficiently.

Figure 6-3: ATCFR
General Model - Central Level



Engineering. The Engineering Section is similar to the "brains" of the department. It is involved in system analysis, system design, testing of equipment, and formulation of strategies for the technical development of the network. It is an internal resource for designing procurement documents involving technical specifications. Its role in network planning is particularly important to ensure that the system is flexible enough to meet the demands for service, yet sufficiently cost-effective in delivering these services to ensure profitability.

Commercial Department. For a telecommunications company operating in a competitive market, it is important to possess a department dedicated to generating profitable sales. The Commercial Department of ATCFR is conceived to focus on just such matters. It will have responsibility for contractual arrangements with the company's clients and other operators, coordination with clients for efficient delivery of the services they require, and costing and pricing formulation. Its purpose is to acquire and retain the subscribers needed to generate sufficient revenues. It is divided into the following three sections:

Sales / Leasing. This section will consist of the sales staff of the company. They will be responsible for selling to small and medium sized potential clients of ATCFR. The external services offered can range from leasing surplus fiber optic pairs and the Railway rights-of-way to selling of various levels of telecommunication services. This section will also be responsible for negotiating service contracts with other telecommunications operators.

National Accounts / Customer Relations. A key business concept for any service company within a competitive market is to be particularly responsive to the needs of its major customers. This section is conceived to be responsible for such matters. The initial major customers will be the SNCFR companies. Large national accounts, such as the Railway, will require special attention to ensure that these clients receive the services they require in a timely and efficient manner.

Market Research. In a competitive market, costing and pricing are essential components to operating a successful enterprise. This section will be responsible for formulating tariffs and leases based on cost analyses and competitive factors. This section will also be involved in formulation of market strategies, and plans for most effectively competing in the commercial market.

Finance & Accounting Department. As an independent telecommunications agency, ATCFR will require its own Finance and Accounting Department. The reason for having its own such department, rather than contracting these services from within the Railway Management Company (SMF), is to ensure that management has the proper accounting information and controls to compete in a fast moving commercial market. Additionally, if an outside joint venture partner is to be involved, then ATCFR, as a joint-venture company, will require its own independent finance and accounting functions.

The Finance & Accounting Department will be responsible for producing timely management information, installing financial controls, keeping financial records, and making and receiving payments. Its purpose is to manage and record ATCFR's financial assets and transactions. It will consist of three sections:

Finance. This section will be responsible for obtaining sources of corporate funding and for managing the debt service of telecom-related credits such as from the World Bank. It will be responsible for maintaining banking relationships and other typical financial functions.

Accounting. This section will be responsible for producing the financial statements of the company and periodic financial reports for company management. In addition, it will perform traditional accounting functions, required to maintain accurate corporate financial records and controls.

Accounts Receivable / Payable. The Receivable component will be responsible for billing and collection of service payments and leases. It will also manage settlements with other telecommunications operators where ATCFR joint services have been provided. The Payable component will manage payable accounts and payroll transactions.

Administration Department. The Administration Department is significant to the smooth operation of an organization. The Department's duty is to manage the variety of details that the operating units need for support, but often neglect, due to other priorities. It is responsible for keeping the company appropriately supplied, staffed, and informed. This department is conceived as having the following sections:

Procurement. This section will be responsible for purchasing the equipment, parts, and supplies required by ATCFR. For this purpose it will

coordinate with the other relevant sections of the organization, such as the Engineering Section. It will also negotiate purchase contracts and equipment leases and manage them after execution.

Human Resources. This section is responsible for coordinating recruitment and for producing company personnel rules and policies, training, managing personnel records, and setting wage guidelines. Because of the technical nature of telecommunications, well-organized training programs will be particularly important.

MIS. Management Information Systems section will develop systems for maintaining the statistical and management-related records for the company, and will have primary responsibility for all computer applications. Well developed MIS systems provide information in the type, quality, and manner necessary for managers to make informed and effective decisions. Particularly important for a technology-based field such as telecommunications, will be computer applications and software specialists. This section will interact with the other departments in order to optimize applications necessary for their functions and operations. Examples include systems performance applications, billing, and accounting applications.

Internal Auditing Unit. In a competitive market, quality and efficiency are essential components for an organization's successful operation. The Internal Auditing Unit is conceived to help managers review the productivity of departments and organizational procedures. It is utilized to help measure the quality of operations and provide a channel to devise how activities can be improved. It also functions to ensure that organizational procedures are being properly followed and inappropriate activities are being addressed. The Auditing Unit is not an operational department but a special unit independent of the departments and directed by the organization's upper management.

Regional Level

ATCFR's regional organization is conceived as being primarily an extension of the Technical Department. Hence, its focus will be on network management, installation, reparation, inspection, and maintenance-related activities. As entry into the commercial market proceeds, some regional commercial presence, in the form of customer relations or marketing, will develop.

Structurally at this level, ATCFR, especially at the initial stages of its development, would likely mirror the Railway's framework of 8 regional offices. As commercial services are provided, particularly in a joint venture form, the regional structure may become less extensive and more centralized in order to keep costs to a minimum.

Figure 6-4, provides a general model for ATCFR's regional level organization.

Adapting the General Model

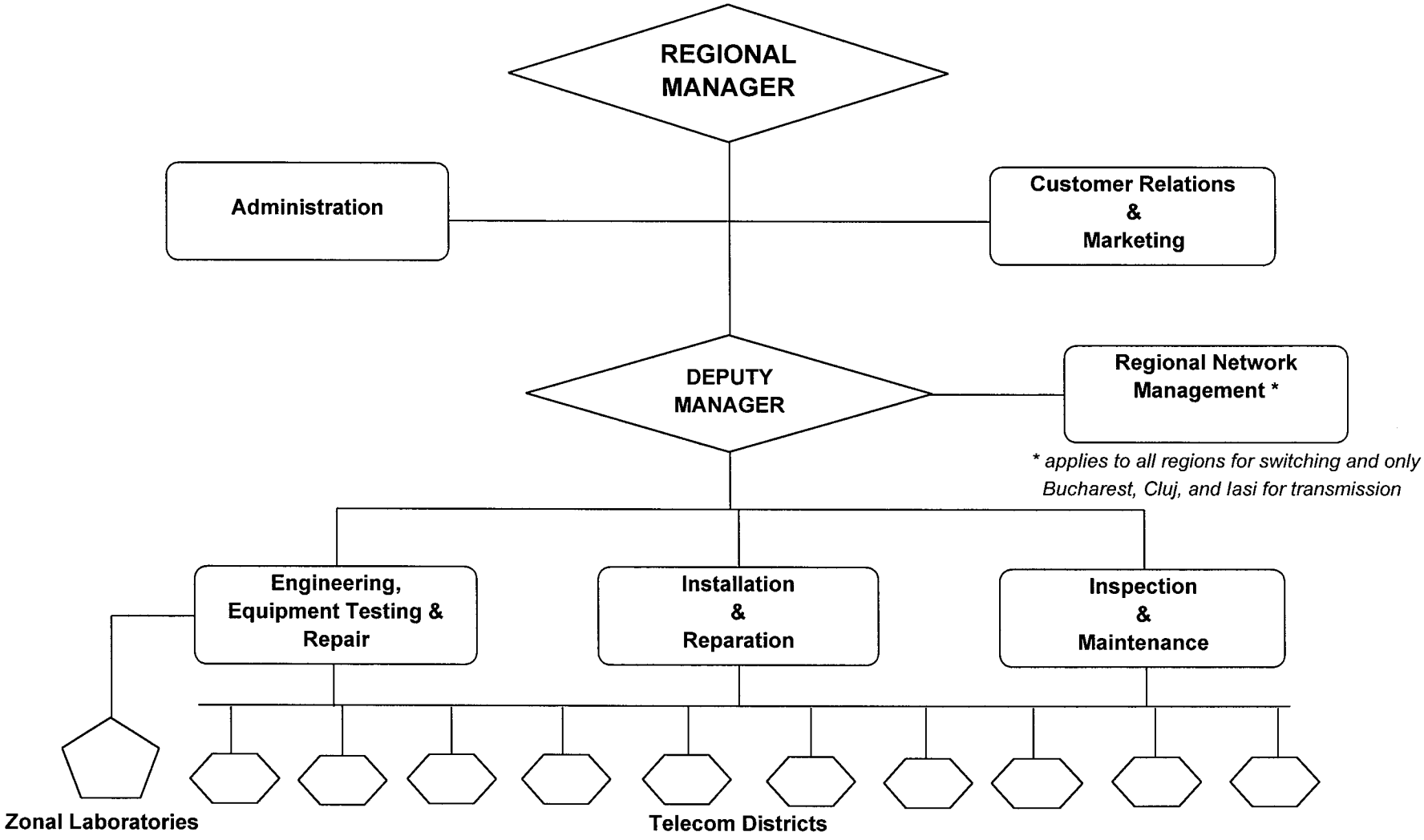
The following paragraphs describe how the focus and structure of each department should be adapted to compete effectively in the market place for telecommunications services.

Technical Department. Doubtless, the technical component of a telecommunications organization is one of the most essential. As was described earlier, SNCFR possesses the requisite skill sets to effectively deliver telecommunications services, though some training and optimization of staff will be required. The Technical Department, as conceived in the general model, provides SNCFR with a well-structured mechanism for channeling its technical expertise to meet the demands of a nationwide telecommunications operation. This can serve not only the internal needs of the Railway, but also those of external commercial entities.

Commercial Department. To the extent that SNCFR enters the competitive telecommunications market, it will require development of sales and marketing operations. The Railway does not now possess significant experience in marketing for telecommunications services. Its small foray into the commercial market is comprised of a certain number of subscribers who use the Railway's telecommunication network, but who are not directly a part of the Railway. These outside subscribers include large freight customers and suppliers, as well as a certain number of public entities that are located near rail lines, such as customs stations, military units, and hospitals. Beginning formally in 2003 (though in a practical sense, beginning sooner), the telecommunications market in Romania will be open to competition from new providers. The earlier SNCFR is involved in positioning itself in this market, the easier it will be to compete for customers.

As the general organizational model indicates, a Commercial Department not only involves sales and marketing, but also cost analysis and tariff formulation. In most

Figure 6-4: ATCFR
General Model - Regional Level



competitive markets, price is a key factor in acquiring customers and gaining market share. To maximize the company's competitive position, the unit responsible for formulating the price structure for SNCFR's telecommunications services must base its figures on accurate analysis of the cost of services. But, cost-based pricing must also be adjusted for competitive considerations in order to win contracts.

Yet, as the margins for competing with lower prices shrink over time due to competition, the quality of service becomes progressively a more important means of differentiating a company, such as ATCFR, from its competitors. Items such as advanced fault detection and analysis, information about the quality and usage of services, and advanced charging functions to optimize service offerings and tariffs, are examples of "quality-based" ways to attract customers and compete more effectively in the commercial market.

Hence, as the scope and intensity of competition increases, the marketing function will become more important. On the other hand, the need for planning and engineering competence also increases with the growth in the demand for more services. This will call for close cooperation between ATCFR's Commercial and Technical Departments.

Finance & Accounting Department. In the general model, we propose that finance and accounting-related activities will take place within ATCFR. The existence of a Finance & Accounting Department within ATCFR will allow the agency to tailor these activities according to its own specific needs. An experienced potential joint venture partner can also provide SNCFR valuable assistance in the practical application of financial and accounting services as it relates to a commercial telecommunications enterprise.

Further, the capital requirements of a modern telecommunications system are substantial. Finance and personnel policies that are governed by rigid regulations, and a civil-service mentality inhibit the organizational development of new entities such as ATCFR, which are attempting to compete in a very fast growing and competitive industry. Potential joint venture partners and investors are, therefore, unlikely to come forward unless ATCFR is granted a high degree of financial and managerial autonomy. Moreover, such autonomy is also important in attracting the necessary funding for the organization's planned development.

Administration Department. The importance of the Administration Department should not be overlooked. If ATCFR is to operate effectively, it will require efficient administrative services. This Department will help ensure that the organization is properly supplied with equipment, personnel, and appropriate information technology. The challenge for ATCFR, as for most organizations, is to size the Department to meet the demands of the agency. If it is too large, it becomes an unnecessary drain on resources. If it is too small, it hinders the effectiveness of operations. Sizing, as is true for all departments in the model, should be based on the scale of activities and extent of commercial market penetration.

Joint Venture Considerations

For the purposes of entering into Romania's commercial telecommunications market, the formation of a joint venture is highly recommended. The joint venture partner(s) can provide the Railway the capital, commercial and financial management expertise, and possibly the added customer base necessary for successful commercial operations within a competitive telecommunications market.

Undoubtedly, the formation of such a joint venture company (JVCo) will take time. In the light of SNCFR's current restructuring, it is likely that a telecommunications entity such as ATCFR will be created before joint venture possibilities are fully explored. Under such circumstances, ATCFR would be the probable "seed" from which a future JVCo would "sprout." As such, the more efficiently ATCFR is organized and staffed, the more attractive it will be to investors and potential joint venture partners. The general model described in this report provides a basis from which to establish this type of efficient organization.

While specific staffing requirements for the organization can be influenced by a variety of factors previously mentioned, Tables 6-2 and 6-3 indicate the general levels of staffing conceived for the JVCo which would be formed from ATCFR. These levels for a start-up JVCo and for a JVCo in 2008 are based on the general organizational model.

Table 6-2: JVCo Startup Staffing

Description	Quantity Employees
Central Level	**31**
Central Management	1
Maintenance & Repair	1
Network Management	1
Engineering	5
Sales / Leasing	3
Customer Relations	1
Cost Analysis / Tariffs	2
Finance	2
Accounting	2
Accounts Receivable	1
Accounts Payable	2
Procurement	3
Human Resources	2
Management information systems	5
Regional Level	**825**
Local Management & Administration	28
Network Management	15
Central & Transit Switching Maintenance	74
Nodal Switching Maintenance	40
Local Switch Maintenance	159
Switch & Electronics Construction	0
Network Transmission Maintenance	45
Local Transmission Maintenance	40
Carrier System Maintenance	64
Fiber Optic Cable Maintenance	48
Aerial copper wire Maintenance	180
Copper Cable Maintenance	39
Urban Cable maintenance	79
Telephone Operators	10
Laboratories (Repair Shops)	4
Radio System Maintenance	*0*
Maintenance for Security of Rwy Circulation	*0*
Data Transmission (X.25)	*0*
Totals	**856**

Table 6-3: JVCo Staffing - 2008
Full Telecommunications Services

Description	Quantity Employees
Central Level	**53**
Central Management	2
Maintenance & Repair	2
Network Management	1
Engineering	11
Sales / Leasing	10
Customer Relations	1
Cost Analysis / Tariffs	2
Finance	2
Accounting	3
Accounts Receivable	4
Accounts Payable	3
Procurement	3
Human Resources	2
Management information systems	7
Regional Level	**1005**
Local Management & Administration	38
Network Management	15
Central & Transit Switching Maint.	116
Nodal Switching Maintenance	80
Local Switch Maintenance	159
Switch & Electronics Construction	35
Network Transmission Maintenance	67
Local Transmission Maintenance	30
Carrier System Maintenance	32
FO Cable Maintenance	72
Aerial copper wire Maintenance	180
Copper Cable Maintenance	26
Urban Cable maintenance	79
Telephone Operators	72
Laboratories (Repair Shops)	4
Radio System Maintenance	*None*
Maint. for Security of Rwy Circulation	*None*
Data Transmission (X.25)	*None*
Totals	**1058**

E. CONCLUSIONS & RECOMMENDATIONS

- There is a natural partnership between a railway and a commercial telecommunications operator. The railway provides the telecommunications operator with the required infrastructure, and the telecommunications operator provides the railway with the needed telecom service expertise.

- Telecommunications in SNCFR is currently distributed among various segments of the Infrastructure Department at both headquarters and the regional level. The more that telecommunications activities can be integrated into a cohesive entity, the more efficient will be the utilization of resources and, hence, the more effective will be the delivery of telecommunications services. Based on this premise, we recommend the establishment of an independent SNCFR Telecommunications Agency - ATCFR.

- As a separate entity, ATCFR will be better capable to provide telecommunications services to the new Railway companies as well as to explore business opportunities in the commercial telecommunications market.

- In order to effectively compete in the commercial market, ATCFR will need to:

  - Streamline its staffing to more efficiently utilize its resources and keep costs down;

  - Develop the organizational structure necessary to address all the major components for efficient delivery of telecommunications services; and

  - Undertake two critical tasks: 1) provide the Technical Department personnel the required training for the transition from the Railway's old analog system to the new digital fiber optic based system; and 2) strengthen ATCFR's commercial expertise, particularly in the areas of sales and marketing.

- Overall, the more that ATCFR can be organized to become an efficient, productive provider of telecommunications services, the more it will be able to attract the necessary capital investment and expertise from investors and potential joint venture partners to develop ATCFR into a quality, profitable enterprise.

SECTION 7:
REGULATORY ISSUES

A. INTRODUCTION

In this Section, we review the regulatory issues associated with SNCFR's entry into a competitive telecommunications market. Discussion of these issues is divided into nine parts:

- Part B provides a general overview of the telecommunications law;
- Part C reviews the legal issues related to licenses under the new law;
- Part D focuses on interconnection issues;
- Part E discusses numbering plans;
- Part F reviews technical regulations related to the telecommunications law;
- Part G focuses on the issue of tariffs under the new law;
- Part H deals with the regulation of radio spectrum usage;
- Part I reviews the regulatory authority under the telecommunications law; and
- Part J summarizes the regulatory framework of telecommunications in Romania.

B. GENERAL OVERVIEW OF THE TELECOMMUNICATIONS LAW

The Telecommunication Law (Law No. 74/1996) was adopted during a joint meeting of the Romanian Chamber of Deputies and Romanian Senate held on June 26, 1996. The Law was promulgated by the President of Romania on July 12,

1996 and was published in the Official Journal of Romania No. 156. Year VII, Part I - Laws, decrees, decisions and other acts - on July 22, 1996 , the same day in which the law went into force.

The Law promotes effective competition in the telecommunications field, by ensuring free participation of any private or corporate individual, entitled by the law, in activities for design, installation, maintenance, possession and interconnection of telecommunications equipment and supply of telecommunications services.

The Law guarantees the free circulation of information by emission, transmission or reception of signals, images or sounds via wire, radio, optical systems, or other electromagnetic media. It also guarantees the secrecy and inviolability of such information.

Since the regulatory provisions for telecommunications services and networks have the public interest in mind, the supply of telecommunications services must be accomplished in accordance with the universal service principle - to ensure a minimal set of services of a pre-determined quality, at affordable prices and throughout the country's territory.

Full liberalization of telecommunications in Romania will be reached, according to the Law (Art.63), by the end of 2002, when the monopoly right of SNTc Rom Telecom S.A. on basic telephone service - i.e. public telephone (voice) service and telex service - will be abolished. After that time, operating licenses for any category of telecommunications services will be granted under competitive rules.

The Ministry of Communications is the Regulatory Authority stipulated by the Law (Art.5).This Authority regulates telecommunications activities, i.e. technical requirements and service-supplying conditions. It also ensures compliance with the decisions of specialized international bodies and organizations to which Romania belongs.

The Regulatory Authority may invest the General Inspectorate for Communications (GIC), a specialized body having the status of an autonomous state enterprise, with powers regarding various functions with the exception of granting licenses. The Regulatory Authority may also authorize competent legal entities to take over and fulfill part of its own technical tasks.

C. LICENSES

Telecommunications services are provided only on the basis of licenses issued by the Regulatory Authority. A license is granted by bids or by direct assignment to legal Romanian entities only for a certain type of service or a certain type of network. The license can be granted for the territory of the whole country, or only for a given geographical area.

The license is not transferable and its duration or validity varies depending on the type of service (Law no.74/1996 Art.11).The validity periods are 15 years for basic telephone service at the national level; 10 years for basic telephone service at the local or regional level; and 5 to 10 years for other services and networks.

The rights and obligations of the license holder are established by the Regulatory Authority in compliance with the Law 74/1996 and are written on the license form.

The fees to be levied for granting licenses are established by Government decisions, depending on an index of inflation in the Romanian economy and changes in tariffs.

The expenses incurred for checking the observance of the license provisions (technical supervision, monitoring of radio-electric spectrum, perturbations etc.) are borne by the license holder, by paying such expenses to the General Inspectorate for Communications.

The Ministry of Communications grants the licenses and authorizations to the operators and service providers in the telecommunications sector (according to the Government Decision concerning organization and operation of the Ministry of Communications, i.e. HG 129/1997, Art. 3, item 5).

The license requirements for GSM or DCS 1800 network installations and operations have been stipulated in the Extraordinary Ordinances of the Romanian Government No. 4/1996 and No. 24/1997.

The GSM 900 MHz license was granted, by means of competitive bidding to two operators, Mobifon S.A. and Mobil Rom S.A. for a period of 10 years. The license fee was $50 million for each.

The above-mentioned acts also stipulate direct assignment of a DCS 1800 license to SNTc Rom Telecom S.A. as well as granting another DCS 1800 license through competitive bidding. The license fee for each is $25 million. The granting of the DCS 1800 license forbids any other rights for installation and operation in the 900 MHz frequency band.

For the period during which SNTc Rom Telecom S.A. keeps its monopoly on the basic telephone service, Law No.74/1996, Art. 64 allows granting, on a competitive basis, some operating licenses for providing basic telephone service in rural areas. Such licenses are limited to rural localities or isolated areas where basic telephone service does not exist or its quality is not satisfactory.

In fact, this article of the Law is inoperative. The Decision of the Government of Romania No. 707/1996, regarding financing telephone works in rural areas and the methodology for its application, stipulates the possibility of implementing telecommunications networks in the rural area using local funds, however, SNTc Rom Telecom S.A. would have exclusive operation and property rights for these investments, and its debts would be reimbursed by providing telecommunications services.

The procedures for granting other authorizations and licenses for various categories of services and networks are settled by the following orders of the Minister of Communications:

- Order No. 366/1997 of the Minister of Communications establishes the conditions under which public operators and independent radio-paging network operators may be authorized and the procedure for granting licenses to them.

- Order No. 14/1998 of the Minister of Communications stipulates the requirements for the authorization of independent telecommunications networks. The implementation and operation of an independent network (a network which ensures telecommunications services to the owner or a closed group of users) are based on an authorization issued in accordance with this Order.

- Order 177/1996 of the Minister of Communications governs the regulatory conditions for implementing and operating VSAT and SNG networks for satellite fixed service communications.

D. INTERCONNECTION

The Telecommunications Law stipulates non-discriminatory access to the networks of dominant public operators (Art. 38 of Law No. 74/1996) and the obligation for the license holders and independent operators to notify the Regulatory Authority on conclusion, modification or cancellation of any interconnection agreement (Art. 39 of Law No. 74/1996).

The Regulatory Authority can cancel partially or totally an interconnection agreement between license holders in case such an agreement jeopardize genuine competition in the telecommunications market (Art. 40 of Law No. 74/1996).

Order No. 175/1998 of the Minister of Communications establishes the obligation of SNTc Rom Telecom S.A. to interconnect its fixed network with any other network whose license stipulates such a right. Additionally, any mobile cellular public network can be interconnected with the fixed network of SNTc Rom Telecom S.A. or with any other mobile cellular public network. There is also the legal right for independent private networks to be interconnected with the public networks.

Order No. 175/1998 also includes provisions as to the methodology for concluding interconnection agreements, the contents of such agreements, as well as the methods for settlement of disputes. It stipulates the responsibilities of SNTc Rom Telecom S.A. for supplying technical information regarding interconnection interfaces and implementation, and as of 2003, a transparent tariff system for interconnection services. For the time being, tariffs are being established by negotiations between parties. At the request of the parties, the Regulatory Authority can arbitrate disputes between such parties and can suspend or cancel an interconnection agreement, if there is a breach of the stipulations set out in Order No. 175/1998.

Order No. 177/1996 of the Minister of Communications forbids both direct and indirect interconnection of VSAT networks and terminals to the public telecommunications network for the purpose of re-transmitting data or voice telephony between the VSAT network and the public network (Art. 4), except in the case of interconnection via leased lines for private use of VSAT terminals for internal communications of a closed group of users or VSAT networks having a coordinating station in Romania meant for data transmissions of legal entities holding licenses in order to supply some telecommunications services that are open to limited competition.

Order No. 14/1998 of the Minister of Communications permits the interconnection of independent telecommunications networks with authorized public telecommunications networks only, while observing the essential requirements regarding the access interface to those public networks. It is forbidden that some traffic generated by other telecommunications networks be transited through independent telecommunications networks (Art. 4 of Law No. 74/1996).

E. NUMBERING

The Regulatory Authority is responsible for developing the numbering plan necessary for telecommunications services to identify the users. It may modify the national numbering plans depending on international agreements, license holders, service providers and users' needs.

The Regulatory Authority also keeps records of numbering groups' usage, changes in the numbering plan, and allocation of numbers to license holders (Law No. 74/1996, Art. 41).

F. TECHNICAL REGULATIONS

Only authorized terminal equipment is allowed to be marketed, connected and used in the communications networks which are the object of a license or an authorization. Unauthorized types of equipment may be commercialized provided that users are explicitly warned about the interaction of their use in connection with the above-mentioned networks.

The Regulatory Authority sets the procedures for authorizing terminal equipment, including technical expert examination and appraisal for which it assigns independent laboratories (Law No. 74/1996).The Regulatory Authority can empower the General Inspectorate for Communications (GIC) to issue and award authorizations for certain categories of equipment.

According to Order No. 8/1998 of the Minister of Communications, type authorizations can be issued for:

- Radio communications equipment (including terminal equipment for cellular networks: GSM, DCS 1800, DECT, etc.); and

- Terminal telecommunications equipment which can be connected to the public switched telecommunications networks.

The equipment type authorization aims at ensuring and certifying the compatibility of a specific type of equipment with the public network, as well as preventing it from causing any perturbations or damages.

The technical expert examination and appraisal is carried out by the National Institute for Studies and Research in Communications (INSCC Bucuresti), based on the technical specifications prepared by this institute in compliance with standards and recommendations laid out in Order No. 165/1992 of the Minister of Communications. The technical expert examination and appraisal can also be performed in the GIC laboratories or other authorized laboratories, as the case may be.

The Romanian Institute for Standardization participates in the telecommunications standardization activity of the European Telecommunications Standards Institute, and is the depository of the ETSI standards in Romania. Both these standards and ITU recommendations represent the technical regulations of reference for communications equipment and networks in Romania.

Design, installation and maintenance activities for telecommunications networks, as well as those regarding installation, maintenance or connection of telecommunications equipment and systems, may be performed only by authorized

persons or legal entities. This provision does not apply for terminal equipment with built-in facilities allowing the user himself to connect it, provided they have explicit approval for this purpose.

Order No.98/1998 of the Minister of Communications regulates the authorization conditions and obligations of those companies performing design, installation and maintenance works for telecommunications networks, as well as the installation, maintenance and connection works for telecommunications equipment and systems.

The expert examination and appraisal of the technical documentation elaborated for the provision of radio communications or CATV services is made by GIC.

G. TARIFFS

Telecommunications services and access to telecommunications networks are provided on a contractual basis involving payment of a tariff depending on the service offered.

The provisions of Law No.74/1996 regarding tariffs stipulate that:

- Tariffs should cover the costs of the services provided.
- Service quality should be ensured.
- Tariffs should not include any additional costs as a result of dominant market position abuses or to subsidize tariffs for competitive reasons.
- Market competition should be ensured and unfair competition should be avoided.

The Regulatory Authority has the power to approve tariff rules or principles.

The tariffs levied by license holders for the basic telecommunications service are approved by the Regulatory Authority and endorsed by the Governmental body responsible for prices and tariffs.

In accordance with Order No. 122/1988 of the Minister of Communications regarding approval of general conditions for telephone service supply, the telecommunications service tariffs to be used by SNTc Rom Telecom S.A. are included on lists approved by the Ministry of Communications and are not subject to negotiation with the customer.

The main types of tariffs are:

- Installation tariffs
- Subscription tariffs
- Telephone call tariffs

The Romanian Government's Office of Competition, which has jurisdiction over prices for monopoly enterprises, is also involved in the establishment of domestic and international telephony tariffs. Rom Telecom must submit tariff changes to the Office of Competition for review and approval to assure that their proposed tariffs are reasonable and justified.[5] The Office of Competition's jurisdiction over telephony ends, however, with the end of the telecommunications monopoly held by Rom Telecom in January 2003.

License and authorization holders in the telecommunications sector pay annually, in compliance with Law No.74/1996 and Government Decision No.153/1997, tariffs for supervision and control of the observance of provisions, regulatory acts, licenses and authorizations for telecommunications, i.e. supervision and control tariffs.

In compliance with the aforesaid regulatory acts, license and authorization holders in radio communications sector pay tariffs for radio-electric spectrum usage management and monitoring, as well as for investigations of electromagnetic perturbations and precautionary measures taken to avoid such cases.

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[5] SNCFR also had to submit their recent telephony tariffs to the Office of Competition for review. Though while Rom Telecom is the sole monopoly for telephony services until 2003, SNCFR has been permitted to extend telephony services to subscribers, who though not officially a part of the Railway, are important shippers or suppliers to SNCFR.

All these tariffs are collected by the General Inspectorate for Communications which is the authority responsible for and empowered to perform such services.

For other services provided upon users' request, GIC charges special tariffs for each service, i.e. tariff for services on request.

Order No. 326/1997 of the Minister of Communications approves the list of tariffs charged by GIC for the services they provide.

H. REGULATION OF RADIO SPECTRUM USAGE

According to the Government Decision No. 153/1997, the General Inspectorate for Communications:

- Participates in developing the policy and strategy of the Ministry of Communications regarding radio electric frequency spectrum utilization;
- Ensures the planning, identification, optimization, assignment and record updating of non-governmental radio electric frequency usage;
- Can modify or withdraw frequency allocations so that the spectrum can be efficiently and reasonably used;
- Controls and monitors, from the technical point of view, the non-governmental radio electric frequency usage to provide radio electric protection to the users; and
- Identifies violations and takes the necessary steps in this respect.

The requirements to be met for acquiring, marketing, experimenting and using any type of radio communications equipment and stations meant for a radio communications service are set out in the "Regulatory Document of the Radio Communications Stations in Romania", approved by Order No. 140/1994 of the Minister of Communications.

Radio electric protection activity is guided, coordinated and monitored by GIC. "The Regulation for Ensuring of Electromagnetic Compatibility", approved by Order No. 134/1994 of the Minister of Communications, stipulates the requirements for supply, experiment, installation and use of devices, equipment and systems causing electromagnetic perturbations or the operation of which may be affected by such perturbations.

"The National Table of the Frequency Band Allocation" complies with the frequency band allocation established by ITU, Article 8 of the ITU Radio Communications Regulatory Document. This document was approved by Order No.261/1993 of the Minister of Communications, modified and supplemented by Orders No. 43/1994 and 142/1995. The Table contains allocation of frequency bands ranging between 9 KHz and 30 GHZ and the limits within which frequencies may be used by the specified services for a certain band.

I. REGULATORY AUTHORITY

According to Law 74/1996 the Ministry of Communications is the Regulatory Authority that supervises licensees, telecommunications service providers and authorized network operators.

To this effect, the Regulatory Authority may request telecommunications operators and service providers to provide any information or documents associated with telecommunications service and network installation, operation and quality. It may request that the licensees should submit annual reports as to their fulfillment of the license provisions or it may ask for expert examination and appraisal of the licensee's, telecommunications service provider's or independent operator's activity.

The Regulatory Authority can delegate to the General Inspectorate for Communications the authority to exercise specific activities and functions, with the exception of awarding licenses.

Under these circumstances and in accordance with the Government Decision No.153/1997 regarding the set-up of the Autonomous State Enterprise, the General Inspectorate for Communications, the activity of the GIC consists of:

- Supervision and control of the observance of regulation, license and authorization provisions for the telecommunications sector;

- Management of non-governmental radio electric frequencies;

- Monitoring of the non-governmental radio electric frequency spectrum; and

- Technical control and assessment of the conformity with the technical norms for the above-mentioned fields.

In order to ensure the electromagnetic compatibility, GIC exercises, at the national level, its activity for certification of the conformity with the technical norms covering:

- Devices, equipment and systems in the telecommunications sector; and

- Devices, equipment and systems generating radio electric waves and those which may be sources of radio-electric perturbations.

The General Inspectorate for Communications can also carry out some other activities, such as: authorization issuance, research and design in telecommunications, radio electric frequency spectrum management, design of information systems, and international cooperation.

The General Inspectorate for Communications treats all the information handled as confidential and applies an impartial and non-discriminatory treatment to all the clients for which it provides services.

The Regulatory Authority can also authorize other competent legal entities to carry out part of its technical tasks.

Any claims concerning decisions made by the General Inspectorate for Communications or other legal entities empowered to perform technical expert

examination and appraisal of equipment, systems and networks are settled by the Regulatory Authority.

The disputes between the Regulatory Authority and license and authorization holders regarding the rights set out in Law 74/1996 are settled according to "The Law of contentious business falling within the competence of the administrative courts".

An Advisory Telecommunications Council was founded on the basis of Law 74/1996, by Orders No. 394/1996 and No. 134/1997 of the Minister of Communications. This Council makes recommendations, on its own initiative or upon request of the Regulatory Authority, in connection with:

- Principles on telecommunications development and regulation;
- Content of licenses; and
- The manner in which users and operators' claims should be dealt with.

The Advisory Telecommunications Council is made up of representatives of telecommunications equipment users, manufacturers, licensees, authorized operators, and experts on technical and regulatory issues.

The Regulatory Authority participates in preparing and negotiating the international agreements and treaties for the telecommunications sector.

Order No. 158/1998 of the Minister of Communications regarding approval of the program for regulatory activities during the period 1988 - 2000 in the postal and telecommunications sector stipulates the regulatory objectives and activities to enable:

- Consolidation of the legislation framework, including:
  - implementation of the law for radio electric spectrum usage; and
  - implementation of the law on numbering utilization.

- Improvement of the institutional framework, such as setting-up of an independent Regulatory Authority by re-structuring the Ministry of Communications and the General Inspectorate for Communications

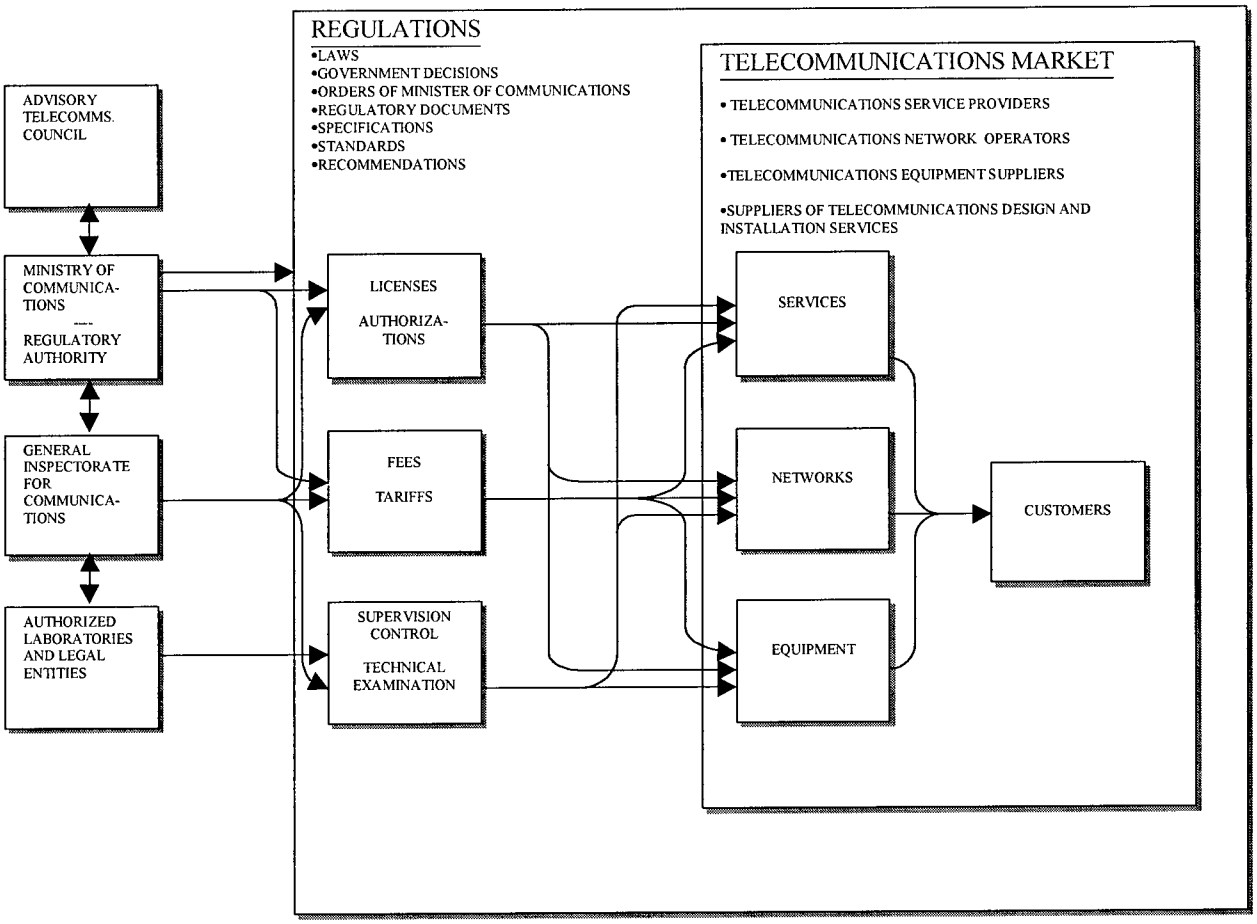
- Liberalization of home market and alignment to the European Community's norms for:
  - liberalization of the telecommunications market;
  - application of EU regulations regarding telecommunications terminal equipment, networks and services; and
  - allocation of the limited radio electric spectrum numbering resources.

- Development of international cooperation, including:
  - turning to good account of the Association Agreement with the European Community;
  - implementation of regulations to attract and stimulate foreign capital and investment; and
  - observance of the timetable for home market liberalization adopted through Romania's commitments to the World Trade Organization

J. SUMMARY OF THE REGULATORY FRAMEWORK OF TELECOMMUNICATIONS IN ROMANIA

The Telecommunications Law No.74/1996 sets out the regulatory framework for the telecommunications market in Romania. In order to guarantee the observance and fulfillment of the provisions of this law, the functions, competencies and responsibilities of the Regulatory Authority in the telecommunications sector have been detailed as laid out in Government decisions and orders of the Minister of Communications (see Figure 7-1).

Figure 7-1: Regulatory Framework of Telecommunications in Romania



The main acts and documents relevant to the telecommunications regulatory framework are the following:

- Telecommunications Law No. 74/1996, published in the Official Journal of Romania, Part I, No. 156; 1996.
- Romanian Government Decision regarding the organization and operation of the Ministry of Communication, No. 129/1997, published in the Official Journal of Romania, Part I, No. 71; 1997.
- Romanian Government Decision regarding the establishment of the Autonomous State Enterprise "The General Inspectorate for Communications" by re-

organization of Autonomous State Enterprise, No. 153/1997, published in the Official Journal of Romania, Part I, No. 81; 1997.

- Romanian Government Decision regarding the foundation of the National Society for Telecommunications "Rom Telecom" S.A. (SNTc Rom Telecom), by the re-organization of the Autonomous State Enterprise "Rom Telecom" S.A., No. 673/1997, published in the Official Journal of Romania, Part I, No. 296; 1997.

- Romanian Government Decision regarding funding of telephony works in rural areas, No. 707/1996, published in the Official Journal of Romania, Part I, No. 284; 1996.

- Romanian Government Decision for the approval of a national strategy for informatization and accelerated implementation of information society and measures program concerning development and large-scale utilization of information technologies in Romania, No. 58/1998, published in the Official Journal of Romania, Part I, No. 93; 1998.

- Romanian Government Extraordinary Ordinance regarding the modification of Art. 63, paragraph (4) in the Telecommunications Law No. 74/1996, No. 54/1997, published in the Official Journal of Romania, Part I, No. 254; 1997.

- Romanian Government Extraordinary Ordinance concerning the products and services for which the prices and tariffs are established by the Office of Competition as stipulated in Art. 4 of the Competition Law No. 21/1996, published in the Official Journal of Romania, Part I, No. 32; 1997.

- Romanian Government Extraordinary Ordinance, to supplement Government Extraordinary Ordinance No. 4/1996, regarding the award of licenses for GSM network installation and operation and the establishment of license fee, No. 24/1997, published in the Official Journal of Romania, Part I, No. 114; 1997.

- Romanian Government Extraordinary Ordinance regarding the award of the licenses for GSM network installation and operation and established license fee, No. 4/1996, re-published in the Official Journal of Romania, Part I, No. 178, 1998.

- Order of the Minister of Communications concerning the foundation of the Advisory Telecommunications Council, No. 394/1996, not published.

- Order of the Minister of Communications to supplement and modify order No. 394/1996 for the set-up of the Advisory Telecommunications Council, No. 134/1997, published in the Official Journal of Romania, Part I, No. 86; 1997.

- Order of the Minister of Communications regarding interconnection of telecommunications networks, 175/1998, published in the Official Journal of Romania, Part I, No. 307; 1998.

- Order of the Minister of Communications regarding authorization of design, installation and maintenance activities for telecommunications network, as well as those for telecommunications equipment installation, maintenance and connection, No. 98/1998, published in the Official Journal of Romania, Part I, No. 171; 1998.

- Order of the Minister of Communications establishing the award procedures for type authorization and approval for individual utilization of terminal

telecommunications equipment, No. 363/1993, published in the Official Journal of Romania, Part I, No. 355; 1994.

- Order of the Minister of Communications regarding the authorization of telephony services, other than multiple access services, No. 364/1993, published in the Official Journal of Romania, Part I, No. 355; 1994.

- Order of the Ministry of Communications to empower the Autonomous State Enterprise, The General Inspectorate for Communications, to issue type authorizations for some types of equipment, No. 8/1998, published in the Official Journal of Romania, Part I, No. 51; 1998.

- Order of the Minister of Communications regarding the authorization of independent communications networks, No. 14/1998, published in the Official Journal of Romania, Part I, No. 86; 1998.

- Order of the Minister of Communications regarding the authorization of public operators and independent radio paging network operators, No. 366/1997, published in the Official Journal of Romania, Part I, No. 51; 1998.

- Order of the Minister of Communications regarding authorization of VSAT networks for satellite services, No. 177/1996, published in the Official Journal of Romania, Part I, No. 108; 1996.

- Order of the Minister of Communications regarding the usage of CATV network infrastructure, No. 93/1997, published in the Official Journal of Romania, Part I, No. 64; 1997.

- Order of the Minister of Communications regarding the approval of the general requirements for telephone

service supply, No. 122/1998, published in the Official Journal of Romania, Part I, No. 231; 1998.

- Order of the Minister of Communications regarding the approval of the list of tariffs applied by the Autonomous State Enterprise, The General Inspectorate for Communications, for services, No. 326/1997, published in the Official Journal of Romania, Part I, No. 20 bis; 1997.

- Order of the Minister of Communications regarding the approval of the Regulatory Activities Program for the period 1998 - 2000, No. 158/1998, published in the Official Journal of Romania, Part I, No. 272; 1998.

- The National Table of the Frequency Band Allocation, approved by the Order of the Ministry of Communications No. 261/1993, modified and supplemented by Orders No. 43/1994 and No. 142/1995, not published.

- The Regulatory Document for Radio Communications Stations in Romania, approved by the Order of the Minister of Communications No. 140/1994, not published.

- The Regulatory Document with regard to ensuring the Electromagnetic Compatibility, approved by the Order of the Minister of Communications No. 134/1994, not published.

A copy of all of the items above that are published and publicly available have been provided to SNCFR under separate cover.

The analysis and evaluation of the main provisions of both the existing regulations and the regulatory activities program (1998 - 2000) show that the telecommunications market in Romania will be fully opened to competition by the end of 2002 and that all the operators in the market will be equally treated.

SNTc Rom Telecom S.A. will benefit, by 2002, from some preferential regulations.

Starting from that time, conditions will be created so that regulations can be reduced, as market competition increases and becomes stronger.

Systematic monitoring of the telecommunications market in Romania and the main players' competitive behavior in this market, as well as ever-growing exigencies of the clients for service will all be decisive factors to bring about an effective decrease in regulations.

SECTION 8:
BUSINESS AND PARTNERING ISSUES

PART I: OVERVIEW

Introduction

In this Section, we focus on developing and evaluating alternative business and partnering strategies for SNCFR to enter the growing communications market in Romania. In our view, the development of the optimum market entry strategy is a prerequisite to selecting appropriate partners and embarking on a new venture with a relatively high revenue potential.

The discussions in this Section are divided into four Parts. In Part I, an overview of alternative approaches for SNCFR's entry into the commercial telecommunications market in Romania. In Part II, experience of selected railroads in the U.S. and Europe is summarized. Part III presents a detailed evaluation of each alternative, followed by our recommendations in Part IV.

A. PRINCIPAL ASSUMPTIONS

We have identified and evaluated five strategic alternatives based on:

- our knowledge of the experience of railways in North America and Europe who have adopted various approaches to expanding their telecommunications operations into the commercial market;
- preliminary discussions with SNCFR management; and
- interviews with a limited number of potential telecommunications customers.

Our evaluation is based on the premises that SNCFR plans to:

- establish a separate, profit-making telecommunications company (ATCFR) to manage the Railway's telecommunications assets;

- continue to provide telecommunications services to the other SNCFR companies and departments; and

- directly or indirectly market telecommunications services to other customers in Romania.

B. ALTERNATE STRATEGIES

Five alternative strategies have been identified to describe the manner by which SNCFR would enter into the commercial telecommunications market. The following paragraphs briefly describe each of these alternatives. A more detailed description and evaluation of these alternatives is included in Part III of this Section.

Alternative 1: "Lease the right-of-way"

Under Alternative 1, the newly established SNCFR Telecom Company (ATCFR) as a subsidiary of the newly established Infrastructure Company (CNCF), would not directly enter the commercial telecommunications business. Rather, it would lease its existing surplus fiber pairs to an independent outside party (NewCo) and would rent the use of the Railway's rights-of-way to install additional fiber pairs to NewCo or to another independent outside party.

Alternative 2: "Go it alone"

Under Alternative 2, ATCFR would serve the internal telecommunications requirements of SNCFR units (the Passenger Company (SNTFdeC), Freight Company (SNTFdeM), Infrastructure Company (CNCF), and other non-operating companies of SNCFR) and would enter the commercial telecommunications business without a foreign business or investment partner.

Alternative 3: "Form a limited joint venture"

Under Alternative 3, ATCFR would reserve for itself ten fiber optic (FO) fibers and associated transmission equipment and would contribute as equity the

remaining ten fibers to a new joint venture company (JVCo)[6]. ATCFR (or CNCF), and one or more experienced foreign and domestic operating partners, and perhaps other passive financial partners, would own JVCo. JVCo would market broadband telecommunications services to independent specialized common carriers and data transmission services to major companies. The Railway's internal telecommunications needs would continue to be provided by ATCFR.

Alternative 4: "Form a full joint venture"

Under Alternative 4, ATCFR would contribute as equity all twenty FO fibers plus associated transmission equipment to JVCo. As in Alternative 3, JVCo would be owned by ATCFR, by one or more experienced foreign and domestic operating partners, and perhaps by other passive financial partners. ATCFR, as subsidiary of the Railway's Infrastructure Company (CNCF), would remain responsible for providing telecommunications services to CNCF, SNTFdeM, SNTFdeC, and the other non-operating SNCFR Companies. As in Alternative 3, JVCo would market broadband and, when necessary, narrow band telecommunications services to independent, specialized common carriers and to major companies for the transmission of data, and beginning in 2003, the transmission of voice. Under Alternative 4, however, JVCo would also provide backbone communications services to ATCFR.

Alternative 5: "Form an outsourcing joint venture"

Alternative 5 is similar to Alternative 4 except that JVCo, instead of ATCFR, would be directly responsible for providing basic telecommunications services to CNCF, SNTFdeM, SNTFdeC, and the other non-operating SNCFR Companies. ATCFR would continue to provide SNTFdeM and SNTFdeC with radio and circulation security telecommunications services.

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[6]In this report we have assumed that CNCF would contribute the fiber optics network and selected portions of its existing telecom network as equity to the contemplated JVCo. Under this assumption CNCF would rely on the dividends from JVCo to service the World Bank loan. Naturally, CNCF could lease rather than contribute these assets to JVCo, but its ownership position in JVCo would be substantially less.

C. EVALUATION CRITERIA

The criteria for evaluating each of the five alternatives focused on the ability of the alternative to:

- Provide and reliably operate a state-of-the art communications system to meet SNCFR's internal requirements;
- Produce sufficient cash flow to service the World Bank loan;
- Attract adequate outside capital to:
  - → fund the purchase and installation of new transmission and switching equipment for the second set of ten FO fibers;
  - → fund the desired expansion of the FO network; and
  - → provide JVCo and ATCFR with the necessary working capital;
- Generate a reasonable rate of return on the Romanian Government's investment under the World Bank's project; and
- Reduce program risks by joining with a management group that has demonstrated experience in successfully marketing and operating commercial FO networks.

We have prepared a list in Appendix 8-A of U.S. companies that are potential joint venture partners or principal sources of supply for telecommunications equipment.

PART II: EXPERIENCE OF NORTH AMERICAN & EUROPEAN RAILWAYS

This Part discusses the lessons learned during the last few decades as various railways in North America and Europe have attempted to expand their internal telecommunications systems to service the external market.

A. EXPERIENCE OF U.S. RAILWAYS

For reasons of safety and improved transportation management, U.S. railways have always invested heavily in telecommunications. As early as 1844, with the invention of the telegraph by Samuel F. B. Morse, railways began installing telegraph lines along their rights-of-way for internal use and for supporting public operators such as Western Union. The advantages of locating telecommunications lines along the railways' rights-of-way were recognized almost immediately. The public telegraph companies and later the public telephone companies only had to make contractual agreements with a few railways to gain permission to string telegraph wires along their rights-of-way. In addition, when there were transmission problems, it was much easier to gain access to the lines if they were mounted along side of the railroad track as opposed to being strung in the middle of a farmer's field.

These trends continued into the Twentieth Century as telephony began to supplant the telegraph, and the railways and public carriers, such as AT&T, started to string miles and miles of copper wire along the railways' rights-of-way. Fifty years later the railways began replacing the copper wire with microwave, and by 1970 to 1980, the railways began replacing analog microwave systems with fiber optic transmission and digital switching. Starting in the late 1950s, the U.S. railways began experimenting with different approaches to exploiting the commercial market potential of their existing telecommunications systems and of the traditional advantages of their rights-of-way.

Following is an overview of selected U.S. railway experiences in commercial telecommunications operations. Of necessity, the discussion is brief, but sufficient relevant information is provided to gain an understanding of the past experience and current conditions in the United States.

The Southern Pacific Railway (SP) Experience with SPRINT

SP was one of the early users of microwave for its internal telecommunications requirements. In the 1960s, SP and IBM jointly developed a state-of-the-art computer-based, operating control system called TOPS. TOPS is an interactive, online system with a central database. It requires a reliable, high quality transmission network. In the 1960s, this level of communication was not universally available from AT&T in the southwestern United States. Thus, SP

built its own microwave communications system stretching from Saint Louis to Dallas, New Orleans, Houston, Los Angeles, San Francisco, and Portland.

In the 1970s, with the breakup of AT&T[7], SP management decided to use its telecommunications network as the foundation for a commercial network and, as a result, formed SPRINT. The initial concept was to use the same microwave towers and buildings that housed SP's internal microwave network for commercial purposes. SPRINT management soon found, however, that for SPRINT to become a national communications company, it would have to expand rapidly beyond SP's present rights-of-way to other areas of the United States. In other words, it became apparent that there was no opportunity for SPRINT to feel its way into the market.

At the same time, fiber optics technology was just being introduced to the telecommunications industry. SPRINT management increasingly realized that if SPRINT was to remain competitive in the external commercial market, it had to replace its microwave system with a fiber optics based system. These requirements for rapid expansion of the network and for the change over from microwave to fiber optics resulted in large annual demands for new capital.

For a variety of reasons, the western U.S. railways, including SP, were operating at about a breakeven during the late 1970s. Thus, SP did not have sufficient capital to support the ongoing requirements of its railway operations and, at the same time, build the necessary network to become a significant competitor in the commercial telecommunications market. As a result, SP sold its SPRINT business to General Telephone and Electric (GTE) in 1983 for just under $1 billion. This sum was probably more than sufficient to offset SPRINT's cumulative annual losses and investment, but because of capital constraints, SP was not able to fully exploit the SPRINT opportunity.

The Norfolk Southern (NS), Santa Fe (ATSF), & SP Railways Experience with FiberTrak

NS is a profitable, well-run railroad, which operates in the southeastern section of the United States. Both the ATSF and SP operate in the western part of the United States. (In the last few years ATSF was merged into Burlington Northern and SP

[7] Since the breakup of AT&T, the U.S. long distance rates have gone down by about 60%, and long distance traffic has almost tripled.

into Union Pacific.) FiberTrak was a joint venture by these three railways, which was formed in 1984 for the purpose of installing a large fiber optics network along their rights-of-way costing about $1 billion. FiberTrak's objective was to market backbone fiber optics transmission capability to MCI, SPRINT, and a number of local and specialty carriers that were trying to establish a niche in the rapidly growing telecommunications market. Each of the three joint venture partners was expected to contribute about $220 million in equity capital with the balance coming from debt financing. The marketing plan was to sign up-front agreements with about ten customers, who would provide more than enough cash flow to operate FiberTrak and to service the debt. The projected high return on the investment would have been based on the expected ability of FiberTrak to attract additional customers.

Despite the fact that the network engineering was completed and the initial customers were signed up, the project was never completed. The Santa Fe management decided at the last minute to withdraw from the project for an unrelated reason. In the mid 1980s the Santa Fe was negotiating to merge with SP, and its management felt that it could not afford the $220 million capital investment in FiberTrak plus the required capital to consummate the merger with SP. Thus, the project was dropped to the dismay of the management of NS and SP.

The Kansas City Southern (KCS) Experience with WilTel

KCS is a smaller railway that operates between the Gulf of Mexico and Kansas City. In the early 1980s, KCS, Williams Pipeline Company, and a small engineering firm formed a joint venture to enter the emerging long distance market. The name of the joint venture was WilTel; it planned to work with a number of other companies to form a national telephone system. WilTel not only laid fiber networks along the KCS rights-of-way, but also along the nationwide pipelines owned by the Williams Pipeline Company which have been abandoned.

The initial objectives of KCS was to reduce its internal telecommunications costs by sharing the use of its microwave network with WilTel and, at the same time, earn some profit from this new long distance market. The objectives of Williams Pipeline Company were similar: to use its unutilized rights-of-way for a new purpose and to realize more than scrap value for its decommissioned pipelines.

Problems started occurring first at KCS. Because of the fact that KCS was operating at about a breakeven point, it was not generating sufficient cash flow to support the voracious capital requirements of both the railway and WilTel. Thus, in 1990, KCS sold its interest in WilTel to its joint venture partner, Williams Pipeline Company. In 1994, Williams sold WilTel to LDDS, who then sold it to WorldCom about a year later. With the anticipated merger of MCI with WorldCom, the new company will become the second largest telephone company in the United States.

SP Railway Experience with Qwest

When the U.S. Federal Trade Commission refused to permit the merger between the SP and ATSF, the former railway was merged into the Denver & Rio Grand Railway Western (D&RGW), and the Southern Pacific name was adopted for both railways. The D&RGW operated between Denver and Ogden, Utah, which was the eastern end of SP's mid-continent line. The principal owner of the D&RGW also owned a small telecommunications company called Qwest, which was set up as a subsidiary of SP. It then began leasing its rights-of-way to other major telephony companies who wished to install fiber optic cables for their own account. In other words, Qwest became a "carrier's carrier", which was the original objective of FiberTrak.

The merger of SP into the Union Pacific in early 1997 did not include the merger of Qwest. Subsequently, Qwest was able to raise sufficient cash to expand into a large, profitable international telecommunications company. Its present market capitalization exceeds $12 billion, and its 1997 revenue totaled almost $700 million, a threefold increase over 1996.

U.S. Railways' Experience in Leasing Their Rights-of-Way

None of the other U.S. and Canadian railways have attempted to enter the market for telecommunications services either alone or with a joint venture partner. All of them, however, have attempted to lease their rights-of-way to the various public telecommunications companies, such as AT&T, GTE, MCI, and SPRINT.

Today the U.S. has more than 15 million optical fiber kilometers, carrying more than 90 percent of all long-distance telephone calls. A striking feature is that 60 percent of the fiber cable is laid along the rights-of-way of American railroads. The

railroads have fully exploited the value in their rights-of-way and been major partners in the telecommunications sector.

Presently the rights-of-way of almost all U.S. railways are leased to telecommunications companies, allowing the latter to place fiber optic cables. Contract terms are all closely guarded as trade secrets and details are rarely available. However, in the 1980s, the annual lease cost for permission to lay fiber optic cable along a railway's right-of-way typically exceeded $2,500 per mile and often required the telecommunications company to permit the railway to use one or more fiber pairs for its internal use. In 1997, the typical annual lease price was about $600 per mile.

Lessons Learned by United States Railways

There were basically two lessons learned by the North American Railways:

(1) Despite the fact that railways have several inherent advantages in providing long distance telecommunication services to other carriers or to the public, no United States railway is engaged in providing such services today. The reasons for this apparent anomaly are based on capital markets. Both railways and telecommunications companies require substantial amounts of capital investment to grow and compete. Nevertheless, there are substantial differences in price/earnings ratios between the two types of companies. For example, the price/earnings ratio for Qwest as an independent company exceeded 400 at the end of 1997. The price/earnings ratio of Southern Pacific before the merger, when Qwest was a subsidiary, was less than 20. In other words, the capital markets are willing to place a much higher value on Qwest as an independent company. This has made it much easier for an independent Qwest to raise the necessary equity capital to expand its business.

(2) The second lesson learned was that leasing the rights-of-way to telecommunications companies has been and should continue to be a good source of outside, risk-free income to U.S. railways. On the other hand, because of normal market forces, U.S. railways are able to command a price per mile today that is less than one third of what they were able to get in the 1980s.

B. EXPERIENCE OF EUROPEAN RAILWAYS

Since essentially all European railway telecommunications companies have until recently been government owned monopolies, their experiences have been somewhat different than the experiences of the privately held companies in the United States. The British and Hungarian experiences illustrate this point.

British Rail (BR) Experience

In the late 1980s, the British Government decided to privatize British Telecom. In order to ensure competition, Britain encouraged the establishment of a second major telecommunications company, Mercury Communications. The Government also required that British Telecom provide "last mile" access lines to Mercury at a reasonable cost. In order to get established in the long distance market, Mercury rented space along BR's mainlines and installed about 20 pairs of optical fibers. As part of the lease payment, Mercury gave back 3 pairs of optical fibers to BR for its internal use.

In the early 1990s, the process of privatizing and breaking up BR began. The general concept was to separate BR into a variety of profit-making companies and to market these companies to private investor groups or companies. As part of this process, British Rail Telecom was formed, which was responsible for all BR telecommunications, but not for signaling. Subsequently, BR Telecommunications and BR's communications infrastructure, including the fiber optic pairs, was sold to RACAL Communications Company for about 120 million Pounds (about $200 million). RACAL Communications Company is a large, privately owned British Company that is in the business of providing telecommunications services plus electronic products to the defense industry and other large industries throughout the World.

Today, RACAL is responsible for providing all telecommunications lines and services to the former BR entities. RACAL charges about 600 pounds per year (about $1,000) for a 64 Kb line, which permits unlimited usage throughout the former BR network plus local "last mile" access. Presumably, RACAL is responsible for paying the local access charges to British Telecom or to Mercury. International calls are billed to each line separately.

Hungarian Railways (MAV) Experience

In several respects, the Hungarian and Romanian environments are similar:

- Both Governments are attempting to privatize their state owned telecommunications companies.
- To make these telecommunications companies more attractive to potential international investors, the Governments have permitted their telecommunications companies to retain their monopolies for most telephony services to extend into the next Century (Hungary until 2002 and Romania until 2003).
- At the same time, the Governments are encouraging their railways to split off and privatize their internal telecommunications departments. On the other hand, until 2002 or 2003, the Governments have generally restricted these railway-based telecommunications companies to:
  - ➜ the transmission of data,
  - ➜ serving the internal communication needs of large companies, and
  - ➜ providing point-to-point communications to companies that already have operating licenses, such as cellular phone (GSM) companies.
- The "last mile" infrastructure in both countries is weak, primarily because the installed copper wire gauges are too small to carry modern 64 Kb digital signals for long distances.

Initially, MAV attempted to form a joint venture relationship with US West, which is one of the U.S. regional Bell companies. Subsequently, US West withdrew from the joint venture. The reported reason for the breakup was the inadequacy of the "last mile" infrastructure to support the transmission of digital signals, particularly since the US West-MAV joint venture market was largely restricted to the transmission of data until 2002. US West continues to have an ownership share in one of the Hungarian GSM companies (WESTEL 900) and one of the radio telephone companies (WESTEL Radiotelefon kft).

In March 1998, MAV formed a new joint venture called PanTel LTD with an initial capital of $100 million. The owners of PanTel comprise:

MAV Rt. 25.1%

Contribution: Use of 4400 km of right-of-way
Use of 720 km of existing optical cable network
Use of 2,700 km backbone network to be completed in 1999.

MOL Rt. (Oil and gas company) 20.9%

One of the largest customers of business telecommunication services (about $20 million per year)

Contribution: Use of its right-of-way along its oil and gas pipelines plus $20 million cash.

KFKI 5%

Leading provider of system integration services in Hungary.

UNISOURCE N.V. 49%

A joint venture of Netherlands' PTT, Sweden's Telia, and Switzerland's Swisscom. UNISOURCE provides cross border communication services for multinational companies. The Company has made substantial investments in the Central and Eastern European (CEE) countries, including Czech Republic's PTT Telecom, Hungary's Pannon GSM mobile service company, and others.

Lessons Learned from European Railways

The lessons learned from the sale of BR's telecommunications department and infrastructure are as follows:

(1) Britain appears to have received a good price from RACAL for BR's telecommunication infrastructure, but none of these funds flowed directly to BR. In addition, the BR infrastructure company, RAILTRACK, has no ongoing ownership interest in the telecommunications company or its profits; and

(2) There has been general satisfaction on the part of the former BR entities with the quality of the transmission lines. There is a general feeling, however, that RACAL does not provide adequate response times when there is a communications outage. This is one of the obvious problems when the company responsible for providing communications services has no effective competition.

PanTel's current management cites the following lessons they have learned from their previous, unsuccessful joint venture attempt.

(1) The growth potential for the data communication market is limited because of the low development level of the IT sector in Hungary. In order to generate enough revenue to compete effectively with the former state owned national telephone company, MATAV, PanTel has to enter the telephony market as well. One approach to overcoming this problem in the short term (prior to 2002) is to provide internal telephony services to large corporations such as MAV and MOL.

(2) The Hungarian telephony market is still attractive enough to enter. The telephony penetration rate in Hungary is still low (26 lines per 100 inhabitants in 1996). Thus, after 2002 there will be a market of sufficient size to support two national telecommunications companies.

(3) Prior to 2002, PanTel must attempt to team up with other large users of communications services in addition to MAV and MOL by offering "virtual private network services" to these potential customers.

PART III: ALTERNATIVE PARTNERING STRATEGIES

There are innumerable alternative business and partnering strategies available to the new telecommunications agency (ATCFR) of CNCF for exploiting the growing market for telecommunications services in Romania. We have identified five of these approaches for discussion purposes, which we believe cover most of the spectrum of choices open to ATCFR. The optimum strategy will probably be a modification or combination of one or more of the strategies discussed below.

This optimum strategy could begin physical implementation following the completion of the new fiber optic (FO) network, now scheduled for sometime in the year 2000. The formation of suitable business and partnering arrangements and the development of marketing programs, however, should begin as soon as possible.

This Part describes each of these five alternatives[8] and presents our view of the relative advantages and disadvantages of each. An assumption is made for each of these alternatives that ATCFR is the agent of CNCF for railway telecommunications.

A. ALTERNATIVE 1: "LEASE THE RIGHTS-OF-WAY"

As shown in Figure 8-1, under this alternative, ATCFR would focus primarily on serving the internal telecommunication needs of its sister SNCFR Companies. In addition, it would act as a leasing agent and landlord to outside companies regarding the use of its surplus fiber pairs and the use of its rights-of-way for the installation of additional fiber pairs. It would not, however, attempt to enter the commercial telecommunications business itself, either on its own or in partnership with another company.

As discussed previously, this approach has been adopted by most railroads in the United States and Canada. There are two primary reasons why the North American railways have shied away from entering the telecommunications business themselves:

(1) Both the railway industry and the telecommunications industry require substantial capital to grow and remain competitive; and

(2) It is much easier and far less expensive for an independent telecommunications company to raise the necessary capital for its internal use than for a railway to raise sufficient capital for the combined railway and commercial telecommunications uses, even for a railway that has a profitable and growing telecommunications subsidiary.

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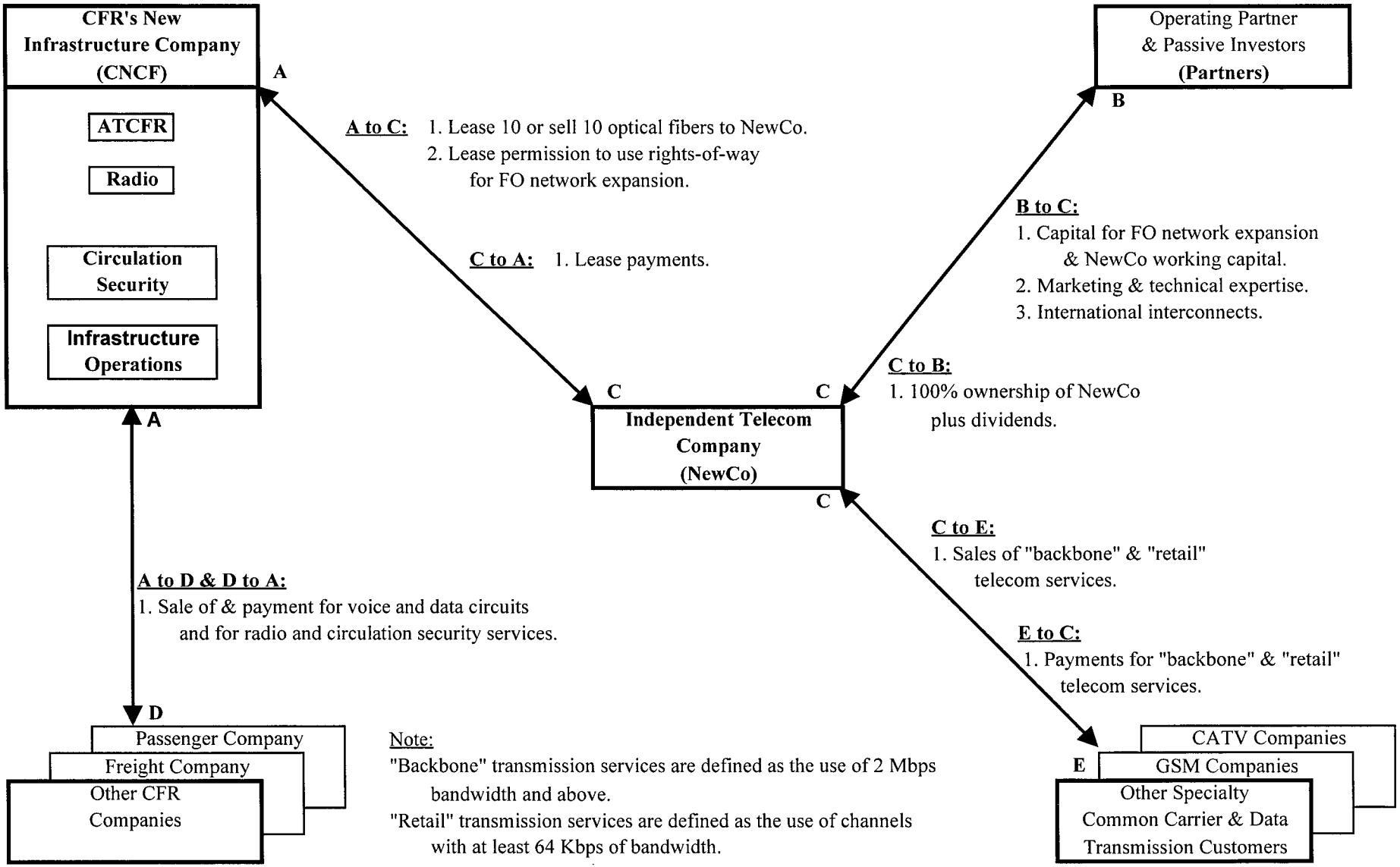
[8] The flowcharts contained in Figures 8-1, 8-2, 8-3, 8-4, and 8-5 illustrate each of these five alternatives.

Figure 8-1

Alternative Strategy 1 Flowchart - "Lease the Rights-of-way"



B. ALTERNATIVE 2: "GO IT ALONE"

Under Alternative 2, ATCFR would serve the internal telecommunication requirements of SNCFR companies and would enter the commercial telecommunications business without the financial or managerial support of foreign businesses or joint venture partners. Figure 8-2 illustrates the organizational relationships envisioned under this alternative.

Although this alternative would have the obvious theoretical advantage of maximizing potential ATCFR profits, it is probably not practical at the present time. Maximizing profit potential of ATCFR would be at the expense of maximizing ATCFR's commercial risks. In our judgement, it would be very difficult for ATCFR on its own to raise sufficient capital and attract the necessary management talent to compete effectively in the commercial telecommunications market.

C. ALTERNATIVE 3: "FORM A LIMITED JOINT VENTURE"

As shown in Figure 8-3, ATCFR would reserve for itself the ten optical fibers and associated transmission equipment under Alternative 3 and would contribute as equity the remaining ten fibers to a new joint venture company (JVCo). ATCFR would be directly responsible for maintaining the initial ten-fiber telecommunications network and for providing telecommunications services to the Passenger Company (SNTFdeC), Freight Company (SNTFdeM), Infrastructure Company (CNCF), and other non-operating companies of SNCFR. In addition, ATCFR, an experienced outside operating partner, and perhaps other passive financial partners would own JVCo. These outside partners would be expected to contribute sufficient capital to JVCo to:

- install the transmission and switching equipment for the second set of 10 optical fibers;
- expand the fiber optic network to cover all of Romania's counties; and
- provide sufficient working capital to cover operating expenses in the early years and for ongoing operations thereafter.

Figure 8-2

Alternative Strategy 2 Flowchart - "Go It Alone"

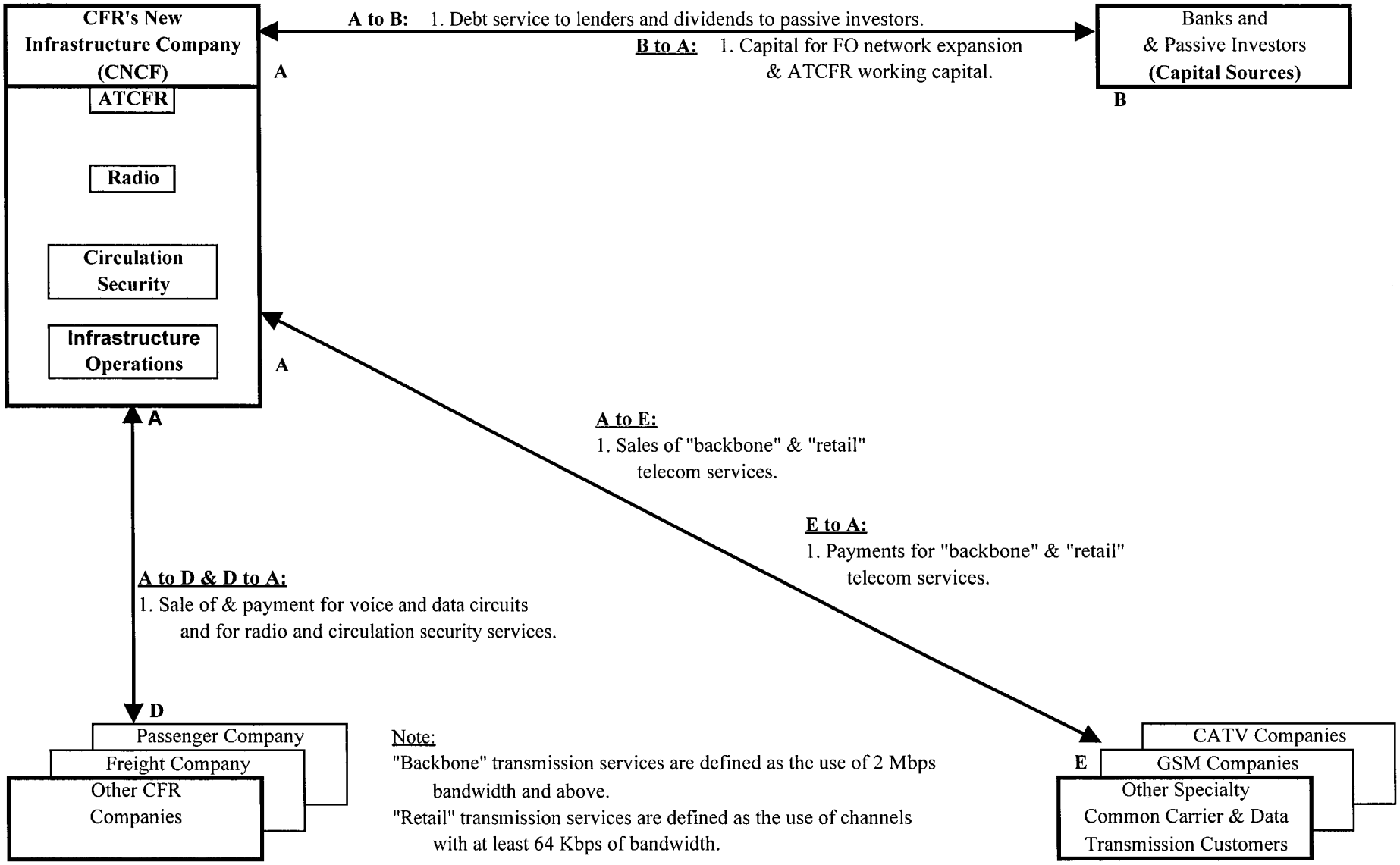
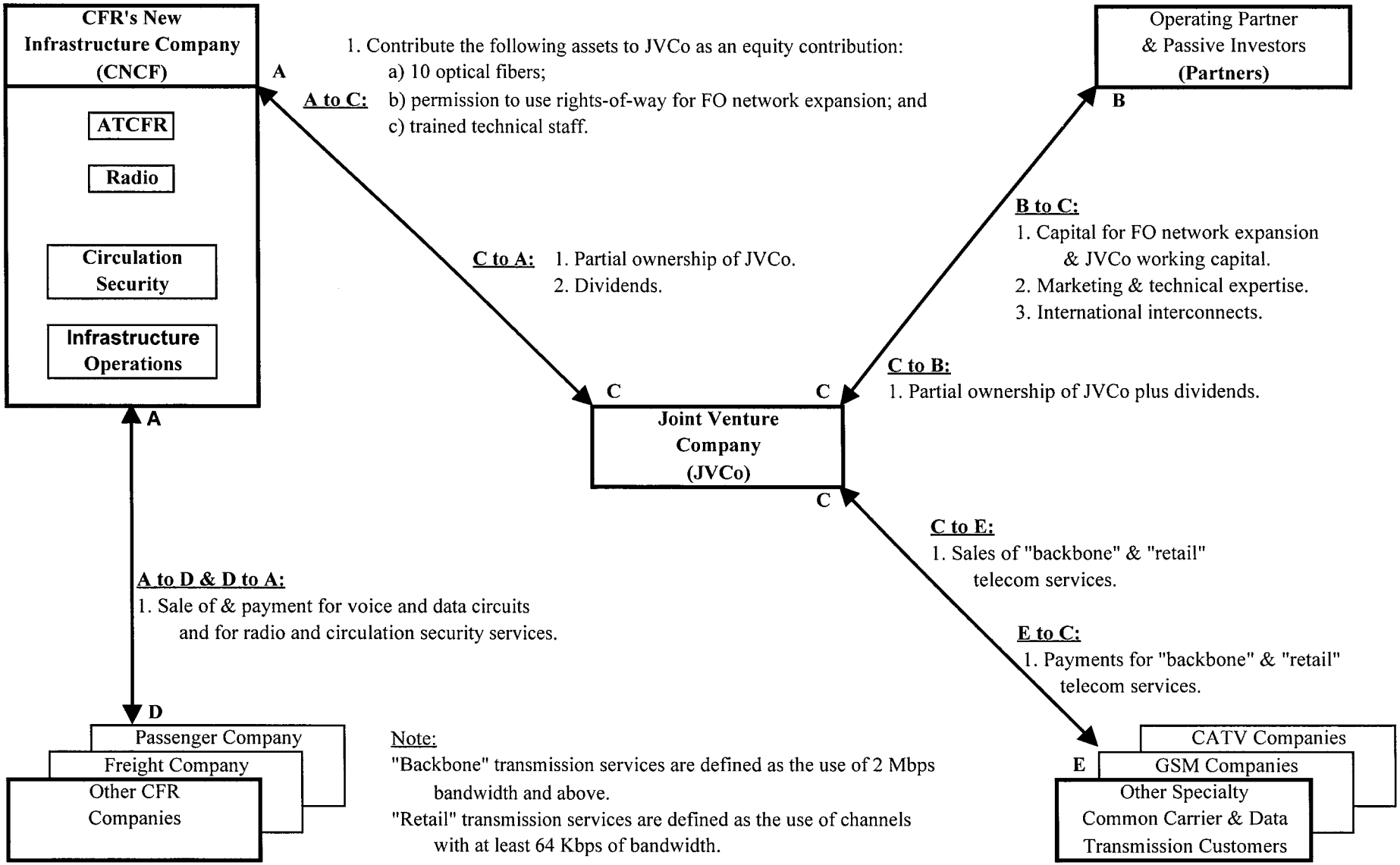


Figure 8-3

Alternative Strategy 3 Flowchart - "Form a Limited Joint Venture"



JVCo would market broadband telecommunications services to independent specialized common carriers and data transmission services to major companies prior to 2003 and compete directly with Rom Telecom thereafter. Ideally, JVCo would be a "carrier's carrier" with respect to marketing only backbone (i.e., 2 Mbps or higher frequency services) to outside customers. Our preliminary market survey of potential customers reveals, however, that there is limited demand for this type of service in Romania because of the level of information technology (IT) development in Romania. Thus, as is the case of PanTel in Hungary, JVCo will also have to offer 64 Kbps services to effectively compete in the market place.

The relative value assigned by potential joint venture partners to the contribution of 10 optical fibers without electronics, plus permission to use SNCFR's other rights-of-way for future expansion is likely to be modest. Thus, the percent ownership of ATCFR in JVCo would also be smaller than under Alternatives 4 and 5 below.

D. ALTERNATIVE 4: "FORM A FULL JOINT VENTURE"

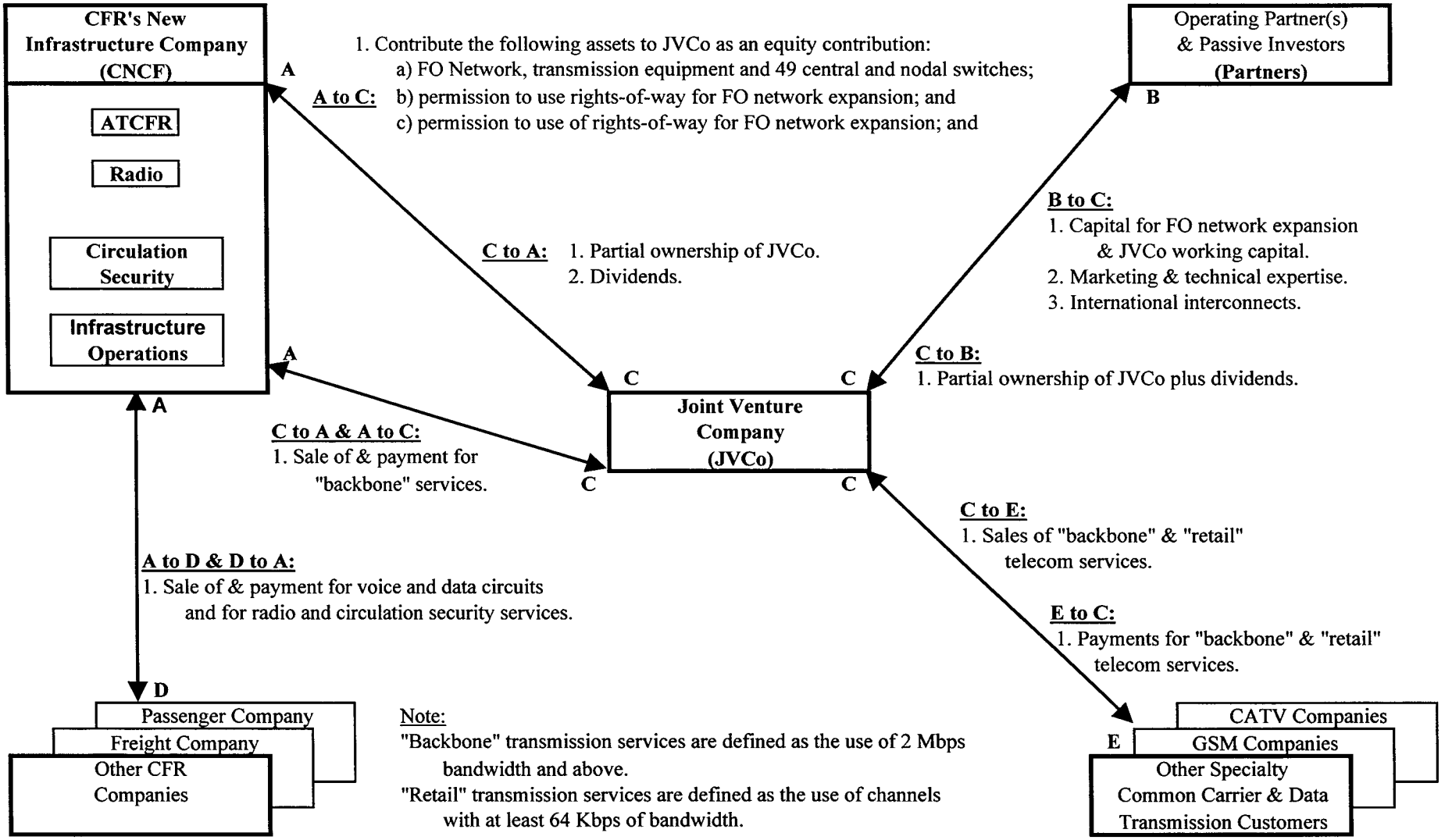
Under Alternative 4, ATCFR would contribute to JVCo all twenty FO fibers plus transmission equipment associated with the initial 10 fibers. As in Alternative 3, ATCFR, an experienced outside operating partner, and perhaps other passive financial partners would own JVCo. ATCFR would remain solely responsible for providing telecommunication services to CNCF, SNTFdeM, SNTFdeC, and other non-operating SNCFR Companies. As in Alternative 3, JVCo would market broadband and, when necessary, narrow band telecommunications services to independent, specialized common carriers and to major companies for the transmission of data prior to 2003. Beginning in 2003, it would compete directly with Rom Telecom. Under Alternative 4, however, JVCo would also earn additional revenue by leasing to ATCFR the backbone communication services carried by the new fiber optics network.

As in Alternative 3, the outside partners would be expected to contribute sufficient capital to JVCo to:

- install the transmission and switching equipment for the second set of 10 optical fibers;
- expand the fiber optics network to cover all of Romania's counties; and

Figure 8-4

Alternative Strategy 4 Flowchart - "Form a Full Joint Venture"



- provide sufficient working capital to cover operating expenses in the early years and for ongoing operations thereafter.

Since in Alternative 4 JVCo would earn additional immediate revenue from the lease of backbone telecommunications services to ATCFR, the ability of raising the desired capital for JVCo and the negotiating position of ATCFR for a larger ownership share of JVCo would be enhanced.

E. ALTERNATIVE 5:"FORM AN OUTSOURCING JOINT VENTURE"

Alternative 5 is similar to Alternative 4 except that JVCo would be directly responsible for providing data telecommunications and telephony services directly to CNCF, SNTFdeM, SNTFdeC, and the other non-operating SNCFR Companies. The capital supplied by the outside JVCo partners would be used for the same purposes described under Alternatives 3 and 4.

Under this alternative JVCo would be responsible for operating and maintaining the new telecommunications network, as well as the existing SNCFR telecommunications infrastructure that would remain after the installation of the new network. ATCFR would remain responsible, however, for providing radio and circulation security telecommunication services to CNCF, SNTFdeM and SNTFdeC.

The commercial relationships between JVCo and CNCF, SNTFdeM, SNTFdeC, and the other non-operating SNCFR Companies would be similar to the relationships between RACAL Communications Company and the former British Rail entities described earlier. JVCo would also market its telecommunications services to non-CFR entities in the same manner as described for JVCo in Alternatives 3 and 4.

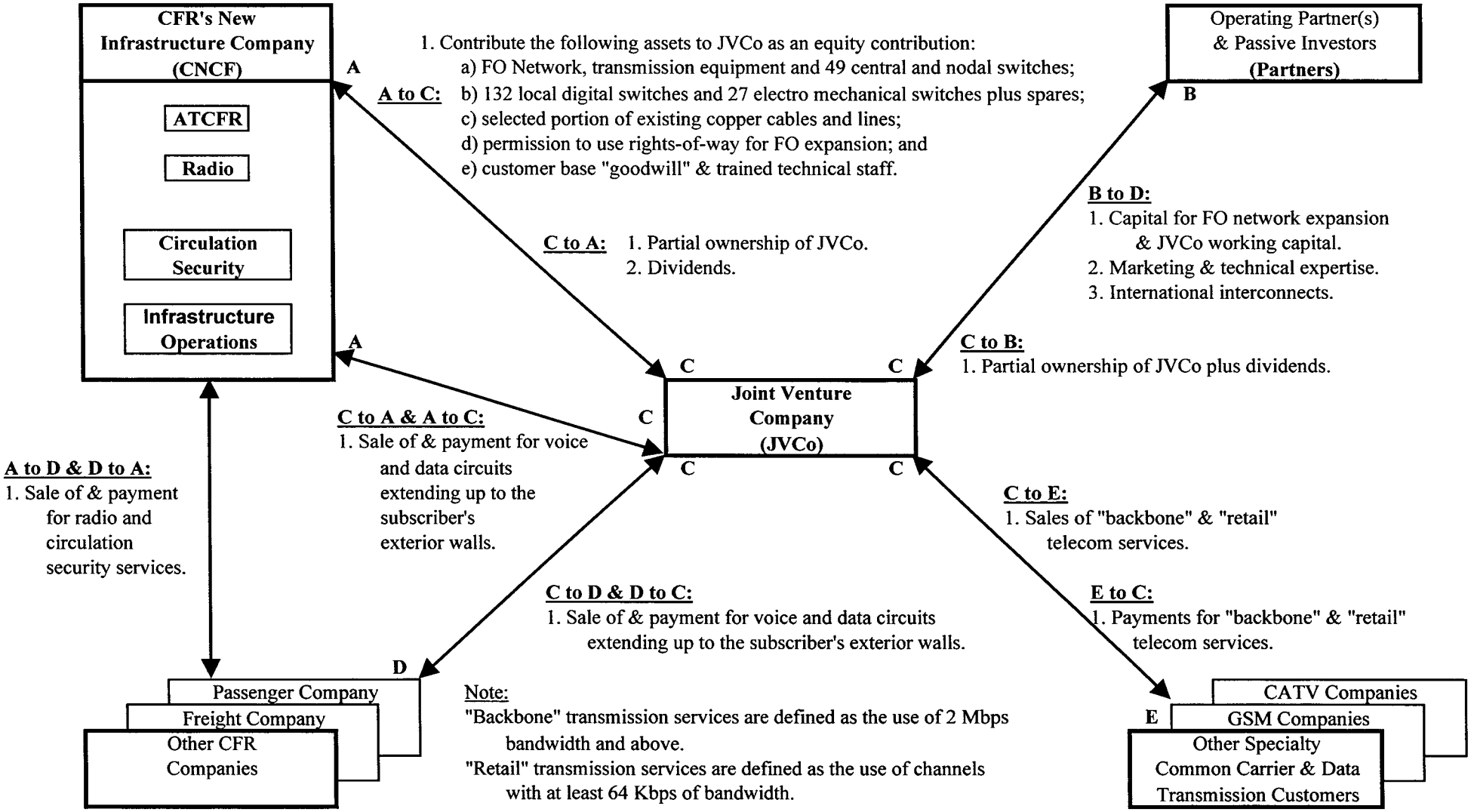
PART IV: RECOMMENDED APPROACH

As one of the means for developing the recommended approach, each alternative was evaluated in terms of its relative ability to:

- Provide and reliably operate a state-of-the art communications system to meet SNCFR's internal requirements;

Figure 8-5

Alternative Strategy 5 Flowchart - "Form an Outsourcing Joint Venture"



- Produce sufficient cash flow to service the World Bank loan;
- Attract adequate outside capital to:
  - ➜ fund the purchase and installation of the transmission and switching equipment for the second set of ten FO fibers,
  - ➜ fund the desired expansion of FO network, and
  - ➜ provide JVCo with the necessary working capital;
- Generate a reasonable rate of return on the Romanian Government's investment under the World Bank project; and
- Reduce program risks by joining with a management group that has demonstrated experience in successfully marketing and operating commercial FO networks.

Table 8-1 summarizes the results of our evaluation of the relative advantages of each of the five alternatives. The alternatives were given a relative score of 1 through 5 for each of the above evaluation criteria, with "5" being the highest relative score and "1" being the lowest.

Table 8-1: The Relative Advantages Of Alternative Partnering Strategies

Evaluation Criteria:	Alt. #1	Alt. #2	Alt. #3	Alt. #4	Alt. #5
Provide quality telecom service to SNCFR.	5	5	5	5	4
Service the World Bank loan.	4	3	4	5	5
Ability to attract outside capital.	1	1	2	3	5
Generate a reasonable return on investment.	2	1	3	4	5
Minimize risks.	1	1	2	4	5
Total	**14**	**12**	**17**	**21**	**24**

Admittedly, the scores included in the table are based on our collective judgement and experience. Although this is not a deterministic optimization tool and no objective basis exists to provide a mathematical proof of the scores assigned, the informed consensus would not be too dissimilar to the numerical values included in the table.

Assuming that all five criteria are equally important, it is possible to add individual scores for each alternative for comparison and ranking purposes. Clearly Alternative 5 appears to be the best, closely followed by Alternative 4 and 3. These three alternatives involve, in one form or another, partnership with an outside investor/operator which has a proven track record in commercial telecommunications. The two least desirable alternatives are for the Railway to "go it alone" or just "lease the right-of-way".

We recommend Alternative 5, the outsourcing joint venture strategy, for the following reasons:

- The near term prospects for the joint venture (JVCo) should be good because it would generate reasonable revenues from the outset by supplying the newly established CNCF, SNTFdeM, SNTFdeC, and the other non-operating SNCFR Companies. Similarly, the longer term prospects for the Alternative 5 joint venture would be brighter than the other alternatives.

- As a result, CNCF should be able to attract quality joint venture partner(s) for JVCo on more favorable terms compared to the other four alternative partnering strategies. More specifically, both the amount of outside equity capital contributed and the relative ownership position of CNCF in the joint venture should be greater under Alternative 5.

- With the reduced interface requirements between JVCo and ATCFR, the structure of Alternative 5 would be simpler than the structure for Alternatives 3 and 4.

- As discussed earlier, the former British Rail entities have experienced some problems with the performance of RACAL Communications Company in providing rapid responses to telecommunication outages. On the other hand, there have been apparently no problems with the quality of telecommunications services provided by RACAL. Unlike the proposed structure of Alternative 5, there is no ownership relation between RACAL and the BR infrastructure company, RAILTRACK. Thus, the resolution of service level problems

in Britain is likely to be more difficult than solving similar problems within the contemplated Alternative 5 structure, because CNCF would remain a major owner of JVCo.

- Under Alternative 5, transfer prices for telecommunications services from JVCo to CNCF, SNTFdeM, SNTFdeC, and the other non-operating SNCFR Companies would presumably be based on normal commercial considerations, although the former SNCFR entities should receive a substantial discount compared to present Rom Telecom rates. Thus, the likelihood of cross subsidization would be reduced, and the economic pressures to increase efficiency in both providing and consuming telecommunications services would be increased.

APPENDIX 8-A

Potential U.S. Joint Venture Partners and Suppliers

POTENTIAL U.S. JOINT VENTURE PARTNERS & SUPPLIERS OF EQUIPMENT TO SNCFR

The companies listed in this Appendix represent a limited sample of all companies operating in the U.S. telecommunications sector. Inclusion of a company in the Appendix does not imply and should not be interpreted as an endorsement of that company's products and services. Likewise, exclusion of a company does not imply any judgement on the part of TERA for the products and services of an otherwise qualified company.

A. Potential Joint Venture Partners

AirTouch Communications
One California Street
San Francisco, CA 94111
Telephone: 415-658-2000
Contact: Mohan Gyani
Executive Vice President
Chief Financial Officer
Vernon H.L. Tyerman
Vice President,
International Operations - Europe

Alltel
1 Allied Dr.
Little Rock, AR 72202
Telephone: 501-901-8000
Contact: Ronald D. Payne
Vice President -
Business Development

Ameritech International
225 West Randolph Street
Floor 18A
Chicago, Illinois 60606
Telephone: 312-609-5700
Telefax: 312-207-1573
Contact: Walter S. Catlow
President, International
Timothy Cawley
President, European Ops.

AT&T
32 Sixth Ave.
New York, NY 10013
Telephone: 212-387-5400
Contact: John C. Petrillo
Corporate Strategy and
Business Development

Bell Atlantic
1095 Sixth Avenue
New York, NY 10036
Telephone: 212-395-2121
Contact: John F. Killian
Group President,
International Telecom

BellSouth International
1100 Peachtree Street, NE
Suite 300
Atlanta, Georgia 30309
Telephone: 404-249-2000
Contact: Carlos Morillo
Director of Business
Development

Cablevision Systems Corp.
1111 Stewart Avenue
Bethpage, NY 11714-3851
Telephone: 516-803-2300
Contact: Joseph W. Cece
Senior Vice President
Strategic Planning

Cincinnati Bell
201 E. Fourth St.
Cincinnati, OH 45202
Telephone: 513-397-9900
Contact: Richard C. Ellenberger
Chief Operating Officer

Citizens Utilities
3 High Ridge Park
Stamford, CT 06905
Telephone: 203-329-8800
Contact: O. Lee Jobe
Vice President, Citizens
Communications

Comcast Corporation
1500 Market Street
Philadelphia, PA 19102
Telephone: (215) 665-1700
Contact: Julian A. Brodsky
Vice Chairman
Brian M. Gibbons
Senior Vice President
Telecommunications
Development

Cox Communications
1400 Lake Hearn Drive
Atlanta, GA 30319
Telephone: 404-843-5000
Fax: 404-843-5777
Contact: David M. Woodrow
Senior Vice President
Broadband Services

Frontier Communications
Frontier Center
180 South Clinton Avenue
Rochester, NY 14646-0700
Telephone: 716-777-1000
Contact: Jeremiah T. Carr
President
Frontier Operations

Global Telesystems Group, Inc.
(GTS)
U.S.A.
1751 Pinnacle Drive
North Tower, 12th Floor
McLean, VA 22102
Telephone: 703-918-4548
Contact: Louis T. Roth
Senior VP, Central Europe

GTS Romania
Str. Traian 2
Bl. F1, Apt. 13-14
Tronson 4, Et. 5
Bucharest - Sector 3
Telephone: (+40) 320-6833
Fax: (+40) 320-6828
Contact: Howard Johnson
General Manager

GTE Corporation
1265 Corporate Drive
Irving, Texas 75038
Telephone: 972-507-5050
Contact: Michael T. Masin
Vice Chairman and
President - International

MCIWorldCom
515 East Amite Street
Jackson, MS 39201-2702
Telephone: 601-360-8600
Contact: Michael J. Rowny
CEO, International
Ventures, Alliances

Media One Group International
(*USWest*)
188 Inverness Drive West
Englewood, CO 80112
Telephone: 303-858-3000
Contact: Robert J. Ford
Vice-President - European
Business Development

Qwest Communications International
Corporate Headquarters
555 17th Street
Denver, CO 80202
Telephone: 303-992-1660, 1400
Fax: 303-992-1724
Contact: Reynaldo U. Ortiz
Senior Vice President of
International

SBC Communications Inc.
175 E. Houston
P.O. Box 2933
San Antonio, Texas 78299-2933
Telephone: 210-821-4105
Contact: John H. Atterbury III
Senior Vice President -
International Operations

Sprint
2330 Shawnee Mission Parkway
Westwood, KS 66205
Telephone: 913-624-3000
Contact: John E. Berndt
President, International

Global One (*Sprint, Deustche Telekom, France Telcom*)
Park Atrium
Rue des Colonies #11
B-1000 Brussels, Belgium
Tel: (+32-2)-545-2000
Fax: (+32-2)-545-2005
Contact: Gerald Wilczek
Country Manager,
Central and South Eastern
Europe

Telephone and Data Systems, Inc.
30 N. LaSalle St.
Chicago, IL 60602
Tel: 312-630-1900
Fax: 312-630-1908
Contact: Scott H. Williamson
Senior Vice President,
Acquisitions and
Corporate Development

B. Fiber Optic Cable and Equipment Manufacturers

AMP Inc.
Corning Glass Works
LDC Inc. Fiber Optics
Communications
Lucent Technologies
3M Fiber Optics Products
Harris Corporation
Nortel
Rockwell International
Siecor Corporation
Stromberg Carlson
U.S. Fiber Optics

C. Data Communications Equipment Manufacturers

Modems

Anderson-Jacobson
Codex Corporation
Concord Data Systems
Digital Equipment Corporation
General Datacom
Hayes Microcomputer
Lucent
Microcom
Mitel Datacom
Mkom

Packet Switching Equipment

Dynatech Communications
Hewlett Packard
Hughes Network Systems
Micom Communications Corp.
Sprint Telenet
Timeplex

Communications Processors

Computer Communications
Control Data Corp. Communications
Digital Equipment Corp.
Lucent Technologies
Micom Communications Corp
Unisys

Protocol Converters

Codex Corporation
Datapoint Corporation
Data General Corporation
Digital Communications
Micom Communications Corp
Timeplex

SECTION 9:
FINANCIAL ISSUES - COSTS

A. INTRODUCTION

The purpose of this Section is to examine the costs surrounding an independent joint venture telecommunications company (JVCo) which would be substantially owned by Compania Nationala de Cai Ferate (CNCF). CNCF is the newly formed infrastructure company made up of the railway infrastructure assets and operations of SNCFR. The Section develops approximate values for various financial segments of the JVCo and comments on current and future financial strengths and weaknesses. The source of much of the basic data in this report is the feasibility analysis that preceded the initiation of the SNCFR digital fiber optic project funded by the World Bank and the Romanian Government. These basic inputs are supplemented by various international telecommunications data and adjustments to reflect the anticipated developments in the future commercial markets.

When considering the commercialization of the fiber optic system, the cost problem divides itself into railway services and commercial network services. The traditional railway telecommunications access services are assumed to remain in place, with some rearrangement for the recently announced divisions of the Railway into five independent companies. The new fiber optic transmission services and the digital switching services become an area with commercial potential. To better examine this commercialization, the cost issues are further divided into increments of capital investment and operating costs.

For the purposes of this report, it is assumed that telecommunications for security of railway circulation, railway radio services and railway telecom terminal services will remain under the administration of CNCF through its telecommunications division - which will be referred to as ATCFR.

The new commercial services, encompassed by JVCo, would administer digital transmissions over the fiber optic network and the digital switching network. The commercial services would extend, in analog mode, over the existing copper wire and cable system to the extent necessary to attain broad coverage for the newly formed Railway companies and outside commercial businesses.

B. CAPITAL COSTS

Digital Fiber Optic Network under the World Bank Project

The cost of the initial 3,535 km fiber optic network project is estimated at $54.8 million. Of this amount, $34 million is in the form of a World Bank loan, and the balance is being funded by the Romanian Government. The system being funded will include not only a fiber cable network but also an international switch, transfer and nodal switches, and 132 local switches. Transmission is accomplished at STM-16, STM-4, STM-1, and 2 Mbps levels depending upon the needs of specific locations on the network. The average cost of the new installation is a competitive $15,500 per km complete with 20-fiber optic cable, transmission equipment, and digital switches.

A summary of the cost components of the system is shown in Table 9-1. Costs are based upon the SNCFR Fiber Optic Feasibility Study which was updated in April 1998.

In Table 9-1, the 15% customs duty is not included in the basic investment cost. The customs duties are absorbed by the Romanian Government in line with requirements for the World Bank loan. However, they are included in capital costs, as recorded in SNCFR's financial statements. The installation labor for equipment is drawn from existing Railway maintenance personnel. While the installation labor is not an incremental cost for this project, nevertheless, labor is allocated to the project cost in proportion to the effort expended.

The investments shown in Table 9-1 put a 20-fiber cable in place but equip only 4 to 8 of the 20 fibers for service, since the initial design for the system has focused primarily on the Railway's internal telecommunication needs. A certain amount of commercial traffic can be accommodated without additional equipment due to the 30% excess switch capacity designed into the system. Additional incremental investments in switching equipment, transmission equipment, add-drop multiplexers (ADM), and connections into external local access networks are required to sufficiently support substantial growth in commercial traffic and eventually place the unused optical fibers in service.

Table 9-1: Cost of Fiber Optic Network

Project component	Project Cost
Planning and Preliminary Engineering	$2,293,041
Fiber Optic Cable (3,535 km)	$10,793,848
Cable Installation (3,535 km)	$9,715,894
Transmission Network (2-4 fiber pairs)	$12,789,160
Digital Switching Equipment (181 locations)	$12,805,016
Other Expenses and Contingencies	$1,246,864
Basic Investment	**$49,643,822**
Customs Taxes @ 15%	$5,150,703
Total with Customs Tax added	$54,794,525

Basis: Constant 1998 US$; 8500 lei = 1 US$; 1.718 DM = 1 US$;
Source: Modernizarea sistemului de telecomunicatii al SNCFR, Faza:Studiu de Fezabilitate, July 1997 revised April 1998;

Shown in Table 9-2 are selected unit costs for the World Bank project. Various additional costs, depending on the engineering of specific equipment, must be added to unit costs to arrive at a comprehensive total. Unit costs will vary between different projects depending upon the types of costs incurred.

Table 9-2: Unit Costs for the World Bank Project

Description	Unit Cost w/o Customs Taxes
Aerial 20-fiber optic cable	$2,913/km
Underground 20-fiber optic cable	$3,306/km
Aerial cable installation	$1,187/km
Underground cable installation	$6,230/km
STM-16 systems (complete)	$781/km
STM-4 systems (complete)	$471/km
STM-1 systems (complete)	$605/km
Average/km for flexible multiplexers	$1,042/km
Average/km for supporting material	$341/km
System items not included above	$2,519,570 lump sum
Average cost per line for switching network	$438/subscriber
Customs duties on imported equipment	Absorbed by the Government

Basis: Constant 1998 US$; 8500 lei = 1 US$

Additional Transmission Equipment

As additional commercial subscribers are added to the system, electronics will have to be added to the initial fiber optic installations. The first additions will occur in the switching equipment, using the residual capacity of the already installed transmission equipment. As commercial traffic builds up and exceeds the initial transmission capacities, additional fiber pairs will have to be equipped and placed in service.

The extent and band widths of this additional transmission capability is unknown at this time. It will depend upon market development and the engineering design of each fiber optic section. Assuming the addition of 100,000 subscribers at 0.20 erlangs/subscriber to the network by the year 2008, an approximation of additional transmission investment is $20.5 million, including customs duties. This estimate

is based upon adding equipment for transmission at the STM-16 level, with STM-1 tributaries, to the 10 fiber rings formed after expansion of the network (see Network Extensions on page 191). The estimate also assumes flexible multiplexers for commercial connections at the same route density as the railway configuration. It is further assumed that the 900 km of additional branches will require little or no increase in transmission capacity.

The transmission speeds and configurations for the remaining fiber pairs will be developed over time with the growth of the commercial market. Three fiber pairs will remain over the total length of the system and additional pairs are available in specific sections of the initial World Bank installation. Unit costs for these incremental investments and configurations can be estimated from Table 9-3 below. These costs vary from World Bank project costs due to the inclusion of customs taxes. Installation is assumed to be accomplished with the existing system maintenance personnel without incurring incremental labor costs.

Table 9-3: Unit Costs for Additional Transmission Equipment

Description	Average Unit Cost
STM-16 Equipment including customs taxes	$898/pair-km
STM-4 Equipment including customs taxes	$542/pair-km
STM-1 Equipment including customs taxes	$696/pair-km
Flexible multiplexers, average railway density w/ customs taxes	$1198/route-km
Support system material (20-30%)	Requires engineering

Basis: Constant 1998 US$; Lei converted @ 8500 = 1 US$

The utilization of the available fiber pairs will vary across the system. For example, utilization in the four southern and southeastern network rings, along with the Constanta Branch, can be expected to be greater than in the northern and western areas.

These new investment requirements do not include the costs of connection for local access operations. Either the Joint Venture company (JVCo) or others such as Internet providers, GSM operators, cable TV operators, etc., will be required to

provide such access services. Following deregulation in 2003, connections to Rom Telecom may also be included. It appears probable that JVCo may have to provide access service alternatives to gain market share.

In summary, the Railway's existing and anticipated traffic can easily be handled over the $54.8 million fiber optic facility currently being installed. The initial system also has a limited capacity to carry startup commercial traffic. As this traffic builds toward an estimated 100,000 subscribers in the year 2008, additional fiber pairs will have to be placed in service. However, this would still leave three or more fiber pairs available for further expansion.

Local Access Projects

The access system is a costly increment for a telecommunications network. The commercial strategies considered for JVCo favor lease line services with local access services provided by others. However, interviews with potential clients indicate a strong preference for 64 kbps services which implies that some portion of JVCo's services are going to require switching services and some portion may require "last kilometer" access services. There are already some small emerging companies in Romania (for data services, GSM services, internet services, etc.) that are providing their own access services, but all providers are to some extent dependent on Rom Telecom. It is thought at this time that these private access services will be insufficient to fill the new fiber optic network's commercial capacity.

Therefore, it is expected that JVCo's switching capacity must be increased. The first increment of this expansion can be accommodated by a 30% reserve built into the World Bank project switching equipment. This can accommodate about 7,000 subscribers. Beyond this point, additional switching equipment must be added to the network at an average cost of $504 per subscriber. This cost includes equipment, network adjustments, and customs taxes. Installation would be with JVCo personnel.

If "last kilometer" service beyond the switch is required, a cost of approximately $500 per subscriber must be added. This cost is predicated on the use of wireless local loop technology. Considering the age, design and reported poor condition of the Rom Telecom local access systems, there can be a considerable demand for improved access services by JVCo or others.

A second area of capital expense for access services is completion of the improvements to the Railway's own access system. A total of 132 local digital switches will be installed under the World Bank project. JVCo will be faced with the replacement of 27 obsolete electro-mechanical switches in outlying locations to complete the Railway's digital communications system. These improvements to the Railway's own access network will allow a wide spread use of data services. More importantly, the new local access system will result in considerably more reliable telecommunications service. HDSL (High rate Digital Subscriber Line) equipment to permit digital transmission over remaining local copper cables may be required to complete the system. The additional 27 digital switches are estimated to cost $3.2 million including customs taxes. Dedicated JVCo installation crews would install the switches.

A summary of unit costs for switching and local access services is shown in Table 9-4.

Table 9-4: Unit cost for Digital Local Access Network

Project Component	Cost per Subscriber
Additional ADM and 2 Mbps flux without switching	$2600 ($87/channel)
Additional lines without adding switch capacity	$300/card
Additional switching capacity for Nx64 kbps service	$438/line
Wireless local loop access service	$500/line
Customs Taxes	Add 15%

Basis: Constant 1998 US$; Lei converted @ 8500 = 1 US$
Source: SNCFR Feasibility Study, July 1997 revised April 1998

The Railway's local access system currently operates in analog mode over copper cables. The new digital system will replace the analog mode operating over the major trunks of the new fiber optic network. HDSL equipment will be used to reach residual locations of significant size left on the copper system.

The proportions for the type of customer access will vary as the market grows. While capital costs for access services are difficult to predict, typical order-of-magnitude estimates can be obtained from Table 9-4. It is noted that the 2 Mbps service can carry more than one subscriber per channel by connection to external switching services.

Installation for access services is to be performed by JVCo personnel. Small jobs can be executed by existing maintenance personnel while larger switch installations can be carried out by specialized installation crews in JVCo's operating budget.

Network Extensions

In Section 5, additional extensions have been recommended for 1,815 km of the fiber optic network. The network extension is estimated to cost $20.7 million. This estimate somewhat differs from the Railway's preliminary estimate of $24.8 million.

Using the World Bank project as a basis for costs, but adding taxes and adjusting repetitive costs, unit costs for the extension project are as shown in Table 9-5. These costs may be used to estimate variations in the planning of extensions.

Table 9-5: Unit Costs for Network Extensions

Description	Unit cost
Planning	5% of construction
Aerial fiber optic cable (installed)	$4492/cable-km
Underground fiber optic cable (installed)	$9987/cable-km
STM-16 equipment	$898/pair-km
STM-4 equipment	$542/pair-km
STM-1 equipment	$696/pair-km
Flexible multiplexers	$1198/route-km
Supporting equipment	$392/route-km
Other equipment and services (20-30%)	Add as needed
Customs taxes @ 15%	Included in prices above
Value added taxes	22% when appropriate

Basis: Constant 1998 US$; 8500 lei = 1 US$; 1.718 DM = 1 US$;

Source: SNCFR Feasibility Study, July 1997 revised April 1998

Supporting costs for supplementary equipment and services, which depend on detailed engineering, must be added to the unit costs above.

The recommended extensions are illustrated in Figure 5-2 on page 103. The ring configurations formed by the extensions utilize vacant fibers installed by the World Bank project. A summary of the extension investments is shown in Table 9-6.

Table 9-6: Capital Investment for 1,815 km Network Extension

Project Component	Cost
Project development costs	$942,722
Fiber optic cable (1238 km aerial; 577 km underground)	$10,554,333
Digital transmission network (STM-16; STM-4; STM-1; multiplexers; network management; synchronization; etc.)	$4,871,228
HDSL Equipment (177 pieces)	$272,959
Other expenses (Const. Mgt.; taxes, commissions, 10% contingencies	$2,513,924
Customs taxes	$1,592,091
Total cost of extension	**$20,747,257**
Value added taxes (22% of materials and contracts)	$4,564,397

Basis: Constant 1998 US$; Lei converted @ 8500 = 1 US$
Source: SNCFR Feasibility Study, July 1997 revised April 1998

The purpose of the 1,815 km extension is to bring service into all of Romania's counties and to increase the ring configurations in the fiber optic system funded under the World Bank project. The plan for extensions into all the counties were developed after the Railway was approached by a potential subscriber for video transmission. Other potential commercial users have also raised the question of coverage to all of Romania's counties. The ring development had been included in earlier planning studies but has been limited by funding. Completing the rings will open additional territory to digital services and will bring the JVCo system to a level of 87% in a "self-healing" configured fiber optic network.

C. OPERATING COSTS

Background

The telecommunications department of SNCFR operates an aging, obsolete private telecommunications network that reaches all of Romania. For the extent of its reach, the network has a relatively few number of subscribers - 26,000. It also provides intensive specialized services to the Railway for the control and safety of train operations as well as radio communications for the railway operations. The result is an essential, but inefficient telecommunications operation.

In Section 8, we have proposed that most of the telecommunications assets of the Railway be contributed to a joint venture company, JVCo, which would be responsible for providing essentially all telecommunications services to the newly formed Railway Companies and to market telecommunications services to external businesses.

The purpose then of this portion of Section 9 is to develop operating costs for the JVCo. To develop these proforma operating costs, we have made certain assumptions:

- CNCF's telecommunications operations and assets will be divided between those that are distinct railway services and those that have the potential to carry commercial traffic;

- A new commercial joint venture (JVCo) will be formed, with CNCF as a principal owner.

- JVCo will hire and train a sufficient number of technically qualified personnel, preferably from CNCF's telecommunications division (which we have referred to as ATCFR), to efficiently operate and maintain the digital fiber optic network. JVCo will also maintain those portions of the older railway telecom assets needed to serve commercial markets.

- JVCo will seek outside operating and investment partners for the purposes of providing experienced commercial telecommunications management and providing funds to expand the fiber optic network.

- JVCo will be responsible for all fiber optic pairs, transmission equipment, and digital switches along with the commercialized portions of the older network.

- JVCo will provide switched telecom services and dedicated line services to the existing or future railway subscribers at discounted rates.

- JVCo will provide commercial services to others as the market dictates.

- ATCFR, as a division of CNCF, will administer specialized non-commercial telecom operations for the safety and circulation of the Railway.

Existing Operating Costs

The general level of ATCFR's annual operating costs is summarized in Table 9-7. These costs are a projection of the first-half 1998 expenditures and do not reflect cost reductions currently underway due to the Railway restructuring. This annualized picture provides a basis for projecting operating costs for JVCo.

The existing organization and cost structure is not suitable for the commercial organization that JVCo must become. It contains the following features not readily adaptable to commercial operations.

- The staff size is too large for the productivity and cost levels that JVCo must achieve.

- The rates of pay are too low for the technically trained personnel that JVCo needs.

Table 9-7: Annualized 1998 Operating Costs

Description	Quantity Employees	Monthly Mon. Salary Lei (mil)	Average Salary US$/Month	Average Salary US$/Year	Estimated Annual Payroll
Personnel					
Central Management	Not				$0
Maintenance & Repair	Identified				$0
Network Management					$0
Engineering					$0
Sales / Leasing	None				$0
Customer Relations	None				$0
Cost Analysis / Tariffs	None				$0
Finance	by SMF				$0
Accounting	by SMF				$0
Accounts Receivable	by SMF				$0
Accounts Payable	by SMF				$0
Procurement	Local				$0
Human Resources	Local				$0
Management information systems	None				$0
Local Management & Administration	268	423	$186	$2,228	$597,176
Supports for Transmission (Cables)	562	683	$143	$1,716	$964,235
Switching Equipment	286	347	$143	$1,713	$489,882
Transmission Equipment	103	125	$143	$1,713	$176,471
Radio Communication	195	237	$143	$1,716	$334,588
Data Transmission (X.25)	12	15	$147	$1,765	$21,176
Security of Circulation and Operations	856	1,040	$143	$1,715	$1,468,235
Telecom Intervention	189	275	$171	$2,054	$388,235
Telephone Operators	400	389	$114	$1,373	$549,176
Totals	2871	3,534			$4,989,176
Materials and Supplies					$4,897,412
Total Operating Cost					**$9,886,588**

Basis: Constant 1998 US$; Lei converted @ 8500 = 1 US$
Source: Telecommunications first half 1998 budget reports

- The organization does not contain a commercially oriented management staff.
- The organization contains specialized railway services that are not commercially oriented (railway circulation and railway radio services).

- The organization contains no financial or administrative functions.

- The costs do not provide for vehicles or supplementary services that have been furnished by other railway departments in the past.

The existing telecommunication staff size appears to be particularly large for a modern commercial telecommunications company. There are historical reasons for this size staff. One is simply the extensive maintenance required by the aging and obsolete system and equipment in place. A second is the legacy of the former non-competitive economic structure of the pre-1989 Government. Table 9-8 illustrates the productivity problem in terms of lines/employee.

The entities listed in Table 9-8 are not strictly comparable. For example, quality of service, age of equipment, and type of customer will also affect main lines per employee measurement. Nevertheless, the data does suggest significant productivity improvement opportunities.

Table 9-8: International Telecommunications Productivity

Country PTT or SNCFR Operations	Main Lines per Employee
Japan	289
Austria	219
England	218
Germany	205
France	198
Turkey	194
United States	190
Hungary	164
Czech Republic	104
Bulgaria	100
Poland	89
Slovak Republic	79
Ukraine	71
Romania	59
SNCFR 1998	18
ATCFR 2008 (without improvement)	36
JVCo 2008	100

Sources: ITU-T 1996 statistics; SNCFR plans and statistics

Future JVCo Operating Costs

JVCo has no choice than to adopt a plan of reorganization to address the commercial market. This will require higher pay scales and increased productivity. Better equipment and careful reorganization of the work will help. The staff reductions will flow back to the remaining employees in higher wages.

If the reorganized JVCo is successful in growing its business to handle 100,000 subscriber lines (26,000 railway + 74,000 commercial) by 2008, it will reach a productivity level of about 100 lines per employee. This level exceeds Rom Telecom performance and is similar to the emerging economies of Bulgaria and the Czech Republic.

The discussion that follows suggests possible changes that could be adopted by either ATCFR in the near term or JVCo after it is formed.

24 Hour Staffing. The equipment being installed is much more dependable than the old, outdated equipment being replaced. 24 hour attendance should not be required at most locations. In fact, there may be existing locations where the incidence of disruptions from faults is so low that 24 hour attendance is not needed. For occasional interventions, duty persons can be called out after hours for extra pay.

Switches and Equipment Rooms. Larger equipment rooms will require personnel on duty to correct network faults. But smaller facilities at the local level should not require constant attendance. Routine preventive maintenance and testing should reduce the workload to productive, daylight schedules.

Aerial Lines. Copper aerial lines are obsolete. They require extensive maintenance, are inadequate for reliable data circuits and do not belong in a modern telecommunications system. Alternatives instead of repairs should be sought. Fiber optics should be used wherever justified by commercial traffic. Leasing circuits from other carriers or establishing radio links are other possibilities whenever costly maintenance is anticipated and traffic does not justify replacement by fiber optics.

Copper Cables. The interurban copper cable system is planned to be preserved as a back-up to the fiber optic network. Based on the experience of others, this approach to back-up seems to be unnecessary, or perhaps only a short term solution. The preservation of the copper cable will require unnecessary labor crews and material supplies for assets that are already near or beyond their service life.

Security of Railway Circulation. The number of personnel involved in telecom security for the circulation of trains is very large. The core of the problem lies in the European station-to-station method of train despatching employed by SNCFR.

This a very labor intensive and communications intensive method that has been replaced with centralized remote control in many parts of the world.

Some changes will have to await the installation of modern signal and switch control facilities (CTC or Centralized Traffic Control and other advanced railway signaling developments) by CNCF (the Infrastructure company). Such developments were started at one time in the past but were abandoned in the face of budget restrictions and the disruption of production capabilities in Eastern Europe.

In the meantime, the productivity of the "security of circulation" personnel should be carefully reviewed. As a minimum, the cost of this telecommunications oversight service should be included in the monthly tariffs charged to the operating companies.

Radio Telephony. SNCFR does not have a dispatcher-to-train radio system. Much of the communications for operations of a modern railway should be handled over such a radio system.

Carrier Equipment. The Railway's telecommunications carrier equipment, used to multiplex channels over the copper cable system, is obsolete and worn-out. Replacement parts are no longer available so the system is maintained by cannibalizing other inoperative equipment. This is a labor intensive operation with marginal results.

The fiber optic system being installed will eliminate a substantial part of this unreliable, labor intensive system. Nevertheless, further efforts are needed to abandon or reduce the carrier transmission system. The planned retention of copper cables as back-up facilities aggravates the situation.

Laboratories. ATCFR maintains laboratories in all eight regions. The primary function of these laboratories is the testing and measurement of equipment. As analog equipment is replaced with digital equipment, the need for these laboratories will be reduced. Factory exchange of electronics parts and equipment should be considered as an alternative for the modern equipment.

Telephone Operators. The telecom system currently employs about 400 telephone operators. When the semi-automatic connections to Rom Telecom are

up-graded by the current project, many of these positions will become surplus. Some residual positions may be needed to connect external callers who do not have the proper internal extension numbers. Also; some centralized operators will be required if JVCo elects to enter the commercial switching market to provide service to dial-up customers.

To estimate the operating costs for JVCo, a summary table has been prepared (Table 9-9). Detailed cost estimates by specific elements of cost are included in Confidential Annexes C, D, and E. The table presents three scenarios - 1) JVCo shortly after startup in the year 2001; 2) JVCo in the year 2008 but limited to switching services to only Railway subscribers, with the balance of traffic coming from dedicated lines and trunk line flows servicing external access providers; and 3) JVCo as a full commercial operation, with a projected 100,000 subscribers, in the year 2008.

The proforma estimates provided in Table 9-9 and other tables throughout this Section assume a constant exchange rate between the U.S. Dollar and the Lei. This assumption in effect implies that any inflation in Lei is offset with a corresponding adjustment in the exchange rate, thus allowing the constant 1998 Dollar as the principal basis for comparison of financial data through time.

Table 9-9: JVCo Operating Costs Projections Summary

Cost Category	2001 Start-up	2008 Full Railway & Commercial Lease-line only	2008 Full Telecommunications Service
Payroll			
Number of Employees	856	840	1058
Total Cost ($ Million)	6.32	12.30	16.36
Supplies & Materials	2.30	2.35	2.64
Equipment Rental	4.76	4.87	4.81
Advertising	.24	.24	.24
TOTAL ($ Million)	13.62	19.76	24.05

Depreciation

Capital depreciation charges are not evident in the SNCFR financial information furnished to the telecommunications division. Charges for JVCo have been calculated on a 20 year straight-line depreciation basis for the new systems being installed. These charges are shown in Table 9-10.

Depreciation charges are non-cash charges that express an acknowledgment of monies spent in previous years for assets that continue to have useful lives in the present accounting period (present year). Depreciation charges normally shelter revenues from taxation. But they also indicate the asset intensity of the business. JVCo will be an asset intensive business and will have to manage the productivity of its assets as well as the productivity of its human resources.

The calculated depreciation charges are incomplete because the residual depreciation from the older portions of the system is not included. These charges are thought to be small due to the low pricing and the old age of the residual system.

Table 9-10: Annual Depreciation Charges

Description	Project Cost	Annual Depreciation Charge
World Bank Project	$54,794,525	$2,739,726
1815 km Project	$20,747,257	$1,037,363
Two Additional Fiber Pairs Project	$20,484,499	$1,024,225
Additional 2 Mbps Multiplexers	$2,990	$150
Additional Switching (per line)	$504	$25

Basis: Constant 1998 US$; 8500 lei = 1 US$; 1.718 DM = 1 US$;
Source: SNCFR Feasibility Study, July 1997 revised April 1998

SECTION 10:
FINANCIAL ISSUES - REVENUES

A. RELEVANT FACTORS

Without reference to existing or potential revenues, costs have little relevance. Yet the subject of revenue projection involves numerous interdependent variables whose values may shift over time and circumstance. In general, potential gross revenues for commercial telecommunications service will be influenced by several factors. Three of the most significant are:

- Type of service offered;
- Market size for the service; and
- Pricing (tariff) structure.

The following is a description of the implications of each of these factors on anticipated telecommunications revenues.

Type of Service

For the purposes of illustration, potential services offered by JVCo can be divided into two major categories:

1) Switched Service - this type of service refers to "dial-up" services where the customer can dial to the location of his/her choice. Usually this activity is routed through network switches. Due to the configuration of the Railway's telecommunications network, which runs over the rail lines, dial-up service will be available for inter urban (long distance) calls over the Railway's network but not for most local calls.

2) Non-Switched (Dedicated Lease Line) Service - this type of service refers to leasing telecommunication lines from "point-to-point" at a specific bandwidth. The customer receives a dedicated line (24 hour access) for data transmission or telephony service between two points for a monthly fee. This activity does not involve routing through network switches.

Market Size

The primary market for telecommunications services is the business user. Compared to residential customers, businesses have much greater telephone usage, volume of long-distance and international calls, and demand for data transmission-related services. In Romania for 1996, while the business sector comprised 11.3% of telephone subscribers, it accounted for nearly 75% of total telecommunications revenues. As shown in Table 10-1, Romania's percentage of business customers to total customers is relatively low. In fact, the percentage of business lines is lowest in Romania compared to other Central and Eastern European countries. This indicates a potential untapped market. Because of the potential to increase the business customer market size and the higher average revenue generated from business customers, the business sector should be the target of JVCo's telecommunications service marketing.

Table: 10-1 Annual Telecommunications Revenue for Selected Countries, 1996

Country	Main Telephone Lines	Residential %	Business %	Total Revenue (US $ Million)	Revenue per Main Line US $
Bulgaria	2,647,500	71.8	28.2	79.7	30
Czech Republic	2,817,200	65.9	34.1	1,158.8	411
Hungary	2,661,600	82.9	17.1	1,287.2	484
Poland	6,532,400	83.0	17.0	2,538.4	389
Romania	**3,161,200**	**88.7**	**11.3**	**559.8**	**177**
Russia	25,914,500	75.7	24.3	5,259.8	203
Slovak Republic	1,246,500	73.8	26.2	476.2	382
Turkey	14,286,500	74.4	25.6	2,566.1	180
Ukraine	9,241,000	75.0	25.0	1,100.8	119
United Kingdom	25,368,000	74.2	25.8	28,561.9	931
France	28,084,900	75.2	24.8	27,336.5	831
Japan	54,528,000	69.1	30.9	93,622.2	1,532
United States	135,337,000	64.9	35.1	182,683.5	1,071

Source: International Telecommunications Union, *World Telecommunication Development Report 1998*, Geneva, Switzerland, 1998, pp. A-9, A- 37, A-65

For non-switched type telecommunications service (dedicated line leasing), the market is comprised of organizations with a specific need for lines dedicated to "point-to-point"activity. The Railway, with the need to communicate between fixed stations, certainly fits into this category. Other potential customers for this

type of service include Internet providers, large banks, data systems, multi-location corporations, and other telecommunications operators. Compared to non-switched service, the market for switched service (i.e., dial-up customers) is much larger. At this level of service, all businesses with a need for "dial-up" long-distance telephony or intermittent data transmission service will be a potential consumer.

Pricing Structure

The pricing framework assumed in our analyses for type of service is based upon the latest published Rom Telecom tariffs (August 1998), shown in Table 10-2. The tariffs are in constant 1998 US dollars. Smaller fees and one-time connection charges have not been included.

Table 10-2: Selected Rom Telecom Tariffs in Constant 1998 US $
1$ = 8500 lei

Service Type	Tariff
Non-Switched Service	
Lease of 64 kbps Line	$3.36 per km (when over 100 km) per month
	$3.86 per km (when between 50 and 100 km) per month
	$5.12 per km (when under 50 km) per month
Lease of 2 Mbps Line	$36.89 per km (when over 100 km) per month
	$42.49 per km (when between 50 and 100 km) per month
	$55.34 per km (when under 50 km) per month
Switched Service	
Subscription service	$3.84 per month
Long distance calls	$.24 per minute in prime time (10am - 4pm)
Local Calls	$.03 per minute

Source: Rom Telecom, *Tariffs for Telephone and Telegraph Services*, August 1998, Chapter I.

B. COMMERCIAL MARKET

As a new company, JVCo must offer a discounted tariff to its potential business customers in order to sell itself. This discount can take two forms. The first would be to apply a percentage discount from Rom Telecom's published rates. A 10% discount from the existing Rom Telecom rates appears to be an acceptable threshold to attract customers. Although no rational basis exists for the assumed discount rate, it appears that 10% is a modest discount, which would not be perceived as a prelude to a "price war" and would not cause a radical response from Rom Telecom.

The second form of discount relates to the basis for applying distance to the tariff rates for leased line circuits. We understand that Rom Telecom prices its leased lines based on the *actual physical routing* of its fiber optics network rather than on the North American practice of using point-to-point *air distance*. Because of the fact that JVCo's fiber optics network tends to be less circuitous than Rom Telecom's network, the leased line distances will normally be less for many point-to-point line leases if JVCo would adopt Rom Telecom's approach of using actual cable route kilometers for measuring distances.

The percentage discount of Rom Telecom's published rates is the form used by TERA in its revenue calculations.

Regardless of how attractive the relative price is, however, JVCo will not be able to succeed in the market place unless it fully satisfies the telecommunications needs of its customers in a responsive and effective manner. It should be assumed throughout this business plan report, therefore, that the service prerequisites are fully met by JVCo.

The following paragraphs describe JVCo's commercial tariff structure for non-switched (dedicated lease line) and for switched (dial-up) services.

Non-switched Services (Dedicated Lease Line)

Rom Telecom's 1996 revenues from leased circuits (non-switched services) amounted to only $9.3 million, which represents 2.2% of the total revenue from business customers. Non-switched (dedicated leased line) services are not yet widely used in Romania. They are expected to grow substantially with the end of

regulation in 2003, however, as new developments in telecommunications motivate large users to benefit from the many advantages offered by dedicated 64 Kbps or 2 Mbps leased lines.

Assuming an average distance of 150 km, each 64 Kbps channel would be priced at $3.02 per km-month (10% discount from the existing tariff of $3.36 per km-month) or $453 per month. The 2 Mbps lease line would be priced at $33.20 per km-month (10% off the existing tariff of $36.89 per km-month) or $4,980 per month for an average distance of 150 km.

The customer, who leases a 2 Mbps bandwidth at a cost of $4,980 per month, would have an average monthly cost of $166 per 64 Kbps line for the 30 channels included in the bandwidth. The cost relationship inherent in the separately priced 64 Kbps line at $453 per month and the grouped 64 Kbps line in the 2 Mbps bundle at $166 per month is such that, if a customer is leasing 11 separate 64 Kbps lines, it would be cheaper to switch over to a 2 Mbps bandwidth. The user would then have access to 30 channels, while paying approximately the same amount. This inherent tariff advantage is common throughout the telecommunications industry.

Switched Services

The monthly subscription for long distance switched service would be $3.46, which represents a 10% discount from the existing tariff. The charge for long distance telephone service is assumed to be $0.21 per minute, which is 12.5% lower that the existing rate of $0.24 per minute. However, since the Railway's network is not configured for local access beyond the rail lines, we must assume that the local components of the long-distance call ($.03 for the originating point and $.03 for terminating point) would be deducted from this revenue. Subtracting $.06 from $.21 leaves an actual long distance revenue of $.15 per minute for the JVCo.

To use these rates in estimating average revenues per month requires an estimate of the average minutes of long distance and local use by business customers. The only source of data to estimate this is from Rom Telecom's published statistics for 1996 reported by the International Telecommunications Union (ITU). In that year,

according to World Bank estimates[9], 75% of Rom Telecom's total revenue of $560 million was generated from business lines, which constituted 11.3% of the total of 3,119,943 installed lines. In other words, approximately 350,000 business lines generated $420 million revenue for Rom Telecom, or an average of $1,200 per year per business line. This translates to an average of $100 per month. If we assume that two thirds of an average business's calls are local (at $.03 a minute) and one third are long distance (at $.24 a minute), then by deducting the monthly subscription rate of $3.84 from the average monthly cost of $100 and dividing the balance by the weighted tariff from the long distance and local call ratio (.30), results in an average monthly long-distance use of approximately 320 minutes.

Based on this assumption of 320 minutes per month of long distance usage per business subscriber, the average monthly revenue of the JVCo for switched service (long distance only) would be $3.46 + (0.15)(320) or $51.46 per line.

Market Size and Service Ratios

In addition to developing JVCo tariffs, it is necessary to make a series of specific assumptions in order to develop annual revenue projections for JVCo's commercial market. The assumptions include:

- The size of the overall market,
- The share that JVCo is likely to capture, and
- The split among JVCo's telecommunications services – in other words, the split among dial up service, 64 Kbps lease line service, and 2 Mbps lease line service.

More specifically, we have made the following assumptions in developing commercial market revenue projections for the years 2001 through 2008. We recognize that innumerable assumptions can be made on this subject; nevertheless, we believe that the collective impact of the following assumptions is reasonable and can be used to evaluate the financial prospects of JVCo.

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[9] The World Bank Staff Appraisal Report; entitled, ***Romania, Telecommunications Reform and Privatization Support Project***; dated March 18, 1998.

- Rom Telecom reported in 1996 that the number of subscriber lines totaled 3.16 million lines and that the market penetration was 14.0% based on a population of 22.6 million. If the number of lines increased by 200,000 per year, which we believe is a reasonable growth rate projection, the number of subscriber lines would total 3.5 million in 1998, 4.5 million in 2003, and 5.5 million in 2008.

- As referred to earlier, Rom Telecom reported to the International Telecommunications Union (ITU) that its business subscribers as a percent of total subscribers was 11.3 in 1996, which was lower than any of the European and North American countries listed in Table 10-1. We project that this percentage will increase to 13% by the year 2003 and an additional 1% per year through 2008. Based on these assumptions, the number of business subscriber lines totaled 357,000 lines in 1996 and are projected to total 585,000 lines in 2003 and 990,000 lines in 2008.

- Two assumptions are required to convert the number of business line subscribers to demand for 64 Kbps and 2 Mbps dedicated lease lines. The majority of JVCo's end-user business subscribers will be the clients of independent local telecommunications providers who will be leasing dedicated point-to-point lines from JVCo. We have assumed that the average utilization of the end-user customers will be 0.10 erlangs; therefore, the local provider will lease one 64 Kbps line to service approximately 10 subscribers. The second assumption relates to the ratio of 64 Kbps lines sold to 2 Mbps lines sold. The theoretical capacity of one 2 Mbps channel is equal to thirty 64 kbps lines. As discussed earlier, based on relative costs, however, the economic ratio of 64 Kbps lines to a 2 Mbps channel is only eleven to one. Thus, the actual average utilization of a 2 Mbps channel lies between eleven and thirty 64 Kbps lines. We have

assumed a value of fifteen 64 Kbps lines per each 2 Mbps channel. Hence, a 2 Mbps line will service approximately fifteen times the number of customers serviced by one 64 Kbps line.

- With the completion of SNCFR's ISDN fiber network, only Rom Telecom and JVCo will have a national telecommunications network. Both will be competing for the business customer. We project that with a focused marketing effort and a state-of-the-art ISDN fiber optics network, JVCo's share of the business telecommunications market will grow from 1% in 2003 to 19% in 2008.

- Initially, we believe that JVCo is likely to provide telecommunication services indirectly to a majority of its business customers by furnishing point-to-point lease line services to local data telecommunications operators, Internet providers, and GSM providers. As time progresses, the percent of lease line business, as a proportion of total business, is likely to decrease. Thus, the percent of customers served by lease lines is projected to decrease a total of 10% during the five year period between 2003 and 2008, and the relative proportion of direct-dial business customers are projected to increase by a like amount.

- Most of the leased line business in 2003 is likely to be handled through 64 kbps lines. As demand for lease line service grows, much of this demand will shift to the larger capacity, more economical 2 Mbps service. More specifically, we project that 2 Mbps lines will constitute only 10% of total lease lines in 2003, and this proportion is projected to increase to 50% by 2008.

- Virtually all countries that deregulated their telecommunications industries and permitted competition to flourish experienced a significant

reduction in tariff rates. Thus, we have projected a 30% decrease in lease line rates between 2003 and 2008. There will be similar pressures to reduce dial-up rates. Since JVCo's digital network will be able to provide ISDN service through dial-up lines to its business customers, however, these customers will be increasingly able to use the lines for simultaneous voice and data transmission. As a result, they are likely to be willing to pay a premium for this capability. These two competitive pressures will partially balance out; thus, we have assumed that tariffs rates for dial-up service will decrease by a rate half that for leased lines.

Table 10-3 summarizes JVCo's commercial market revenue projections based on the above assumptions.

C. RAILWAY MARKET

We have assumed that JVCo will possess the telecommunications assets of the Railway, and will have a commitment to serve the telecommunications needs of the Railway at an acceptable tariff. Considering the relationship of JVCo to the Railway and the quantity of telecommunications services being provided, we have based our revenue projections on the assumption that the telecommunications services will be provided at a 50% discount from Rom Telecom tariffs.

More specifically, the potential revenue from providing dedicated lease line and dial-up telecommunication services to the Railway companies is based on the following assumptions:

Non-switched Services (Dedicated Lease Line)

- **Dedicated Lines for Pre-IRIS Data Network.** The Railway's eight regional headquarters will be connected to Bucharest via 2 Mbps channels with an average length of 250 km. Rom Telecom's current tariff for 2 Mbps channels is $36.89 per km - month or $442.68 per km per year, which, after the 50% discount, translates to $221.34 per km per year. The eight regional

Table 10-3: JVCo Revenue Projections - Commercial Market

Assumptions:

A	Average Business Customers per 64Kbps Lease Line	10	*(Assuming an average erlang of 0.10)*
B	Average 64 Kbps lines per 2Mbps Line	15	
C	Average Business Customers served per 2 Mbps Line = *A*B*	150	

		1998 Monthly Tariffs	*Yearly Change*	2003	2004	2005	2006	2007	2008
D	Total Customer Lines in Romania (000s)		*200*	4,500	4,700	4,900	5,100	5,300	5,500
E	Percent Business Lines		*1%*	13%	14%	15%	16%	17%	18%
F	Total Business Customer Lines in Romania (000s)=*D*E*			585	658	735	816	901	990
G	Percent JVCo Market Share		*3.5%*	1%	5%	8%	12%	15%	19%
H	**Total Business Customer-Lines Served Directly or Indirectly by JVCo (000s)=*F*G***			**5.9**	**29.6**	**58.8**	**93.8**	**135.2**	**183.2**
I	Percent of Customers Served by Lease Lines Directly or Indirectly by JVCo		*-2%*	75%	73%	71%	69%	67%	65%
J	Percent of Customers Served by Dial-up Lines			25%	27%	29%	31%	33%	35%
K	2 Mbps Lines as a Percent of Lease Lines		*8%*	10%	18%	26%	34%	42%	50%
L	**Customers Served By Lease Lines Directly or Indirectly by JVCo (000s) = *H * I***			**4.4**	**21.6**	**41.7**	**64.7**	**90.6**	**119.0**
M	Number of 64Kbps Lines = *H / {A + [(A*B*K) / (1-K)]}*1000* ** See Note*			165	504	666	742	763	744
N	Number of 2 Mbps lines = M * *[K /(1-K)]*			18	111	234	382	553	744
P	Number of Lease Lines = *M + N*			183	614	900	1,124	1,316	1,488
Q	**Customers Served By Dial-up Lines by JVCO (000s) = *H * J* Note: *1 Dial-up line serves 1 Business Customer***			**1.46**	**7.99**	**17.05**	**29.09**	**44.60**	**64.10**
R	Number of Dial-up Lines = *H * J * 1000*			1,463	7,995	17,052	29,090	44,600	64,103
S	JVCo Total Number of Lines = *P + R*			1,645	8,609	17,952	30,215	45,916	65,591
	Percent of 1998 Tariff Rates								
T	for Lease Lines		*6%*	100%	94%	88%	82%	76%	70%
U	for Dial-up Lines		*3%*	100%	97%	94%	91%	88%	85%
	Annual Revenues ($ millions):								
V	From 2 Mbps Lines = *12 * $4,980 * N * T*	$ 4,980		$ 1.1	$ 6.2	$ 12.3	$ 18.7	$ 25.1	$ 31.1
W	From 64k Lines = *12 * $453 * M * T*	$ 453		0.9	2.6	3.2	3.3	3.2	2.8
X	From Dial-up Lines = *12 * $51.46 * Q * U*	$ 51.46		0.9	4.8	9.9	16.3	24.2	33.6
Y	**Total Annual Revenue = *V+W+X***			**$ 2.9**	**$ 13.6**	**$ 25.4**	**$ 38.4**	**$ 52.5**	**$ 67.6**

* Note:
The basic formulae from which the number of 64 kbps lease lines (M) and 2 Mbps lines (N) are derived equal:
*H = (A*M) + (C*N) and N=M*[K/(1-K)]*
Using the above basic formulae, through an algebraic exercise the formulae for calculating the values of M and N can be derived.

headquarters will be connected with 64 Kbps leased lines with the 1,334 railway stations. The average length of these 64 Kbps lines is estimated to be 50 km with a tariff of $23.16 per km per year (assuming a 50% discount from the Rom Telecom 50 km rate of $3.86 per month or $46.32 per km per year).

- **Short Distance Dedicated Leased Lines between Railway Stations and Their Surrounding Facilities.** Each of the 1,334 stations will have on average 10 dedicated leased lines of 5 km each for communication of station management with outlying facilities. Rom Telecom's current tariff for dedicated 64 Kbps lines of less than 50 kilometers is $ 5.12 per month or $61.44 per year. After applying a 50% discount this translates to a railway tariff of $30.72 per kilometer per year.

- **Dedicated Lease Lines for the New PRTS System.** There will 200 dedicated 2 Mbps channels between Bucharest and servers located throughout Romania to service the new Passenger Reservation & Ticketing System (PRTS). The average length of these channels will be 250 kilometers and the annual Railway tariff rate will be $221.34 per kilometer (assuming a 50% discount of the Rom Telecom rate). There will be a required investment by JVCo of $5,000 per server or a total of $1 million to service this application. In addition, there will be an average of 10 short distance 64 Kbps dedicated lines per server for connection to the ticketing and reservation terminals. The average distance and applicable Railway annual tariff rates for these lines will be 10 kilometers and $30.72 per kilometer, respectively.

Switched Services

Dial-up telephony services will be required for the 24,000 Railway subscribers plus approximately 2,000 major shippers. For dial-up services to the Railway companies, JVCo will have the ability to provide both long-distance and local call services. This assumes that the average Railway subscriber's calls will remain

within the network's service area and do not need to connect to an outside server's local access network. An assumed average of 5 minutes of telephone usage per hour translates into 40 minutes per working day and into 800 minutes per subscriber per month. For the commercial market, we assumed that the calls of the average business subscriber would be two-thirds local and one-third long distance. For the Railway, due to the inter-urban nature of its business, we assume half of its calls will be long distance and half will be local. Thus, for an average Railway subscriber, there will be an average of 400 minutes per month of local calls at a 50% discounted tariff of $.015 per minute and an average of 400 minutes per month of long distance at a 50% discounted tariff of $.12 per minute.

Dial-up Telephony Services for Railway Subscribers. Starting with the year 2000, a 6% decline in the 24,000 Railway subscribers is incorporated in the calculations to allow for organizational changes, reduction in labor intensive activities due to modernization, and general changes in telephone quantities and usage. The 2,000 subscribers comprised of major shippers of the Railway is estimated to remain constant. Similar to the commercial market assumptions, annual reductions of 6% for leased line tariffs and 3% for dial-up tariffs are incorporated in the calculations.

Given these assumptions, Table 10-4 presents the estimated annual revenues from the Railway by year and type of service.

D. COMBINED MARKET REVENUES

Table 10-5 combines the projections for both the commercial and Railway markets to present the total estimated revenues for JVCo from 2001 (the year the World Bank project fiber optic system is estimated to be fully operational) to 2008. Over this time period, the general pattern of revenue share by market is clearly defined. In the initial years of JVCo's operations (2001 - 2004), the primary source of revenue will be the Railway market. This is particularly true for the two years prior to the official end of the Rom Telecom monopoly on basic telecommunications services in 2003. As the JVCo's activities in the commercial telecommunications market increases and its share of this market grows, over two-thirds of its revenues will be generated outside the Railway market by the year 2008.

Similarly, the pattern in the revenue shares within the JVCo's commercial market activities, displays the steady growth of dial-up activities. By the year 2008, commercial market dial-up activities are projected to comprise over 50% of JVCo's overall revenues.

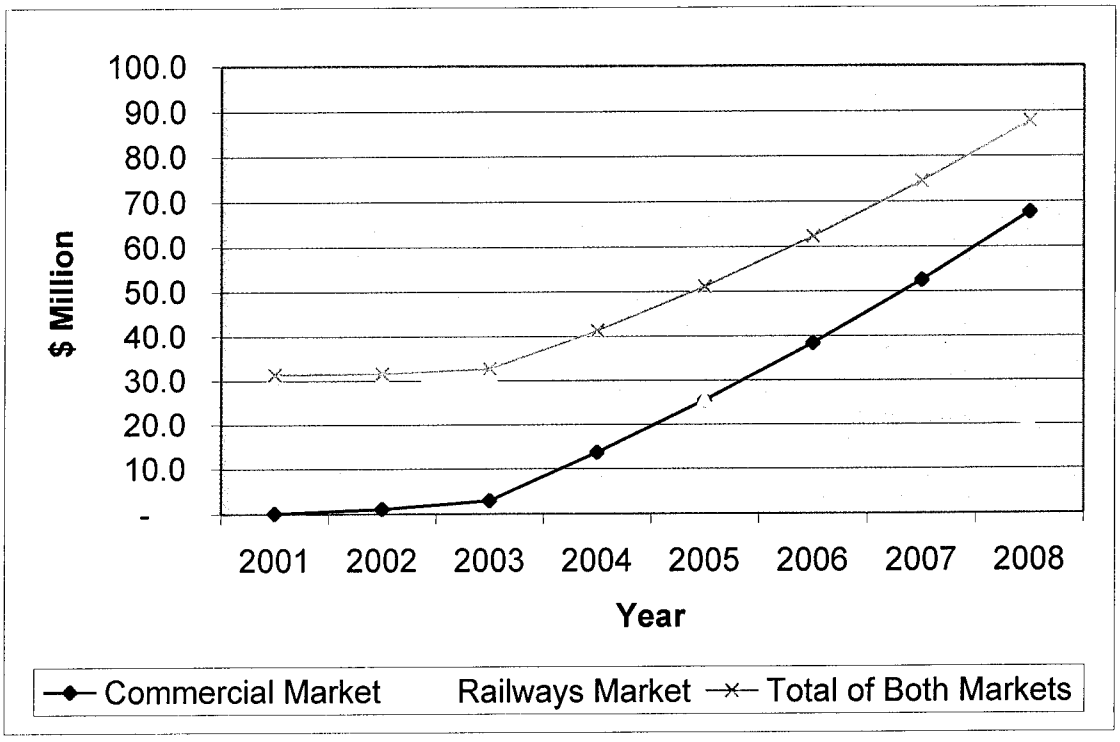
Table 10-4: Projected Revenue from Railway Companies

	Assumptions:								
A	Percent Discount from Rom Telecom Rates		50%						
B	Average Hourly Usage Per Business Day		5 minutes						
C	Minutes per Month=*8*20*B*		800						
D	Percent Long Distance		50%						
E	Percent Local		50%						
F	Pre-IRIS 2 Mbps Leased Line km		2,000						
G	Pre-IRIS 64 Kbps Leased Line km		66,700						
H	Satellites 64 Kbps Leased Line km		66,700						
I	PRTS 2 Mbps Leased Line km		50,000						
J	PRTS 64 Kbps Leased Line km		40,000						

		1998 Annual Tariffs	*Yearly Change*	2003	2004	2005	2006	2007	2008
	Percent Decrease in 2003 Tariff Rates								
K	for Leased Lines		*6%*	100%	94%	88%	82%	76%	70%
L	for Dial-up Lines		*3%*	100%	97%	94%	91%	88%	85%
	Annual Revenue from Leased Lines:								
	Pre-IRIS Data Network :								
M	2 Mbps Lines ($ Millions)= *F*K*$221.34/1000000*	221.34		$ 0.4	$ 0.4	$ 0.4	$ 0.4	$ 0.3	$ 0.3
N	64 Kbps Lines ($ Millions) *G*K*$23.15/1000000*	23.15		1.5	1.5	1.4	1.3	1.2	1.1
P	Station Satellite Networks ($ Millions)= *H*K*$30.72/1000000*	30.72		2.0	1.9	1.8	1.7	1.6	1.4
	PRTS Network:								
Q	2 Mbps Lines ($ Millions)= *I*K*$221.34/1000000*	221.34		11.1	10.4	9.7	9.1	8.4	7.7
R	64 Kbps Lines ($ Millions) *J*K*$30.72/1000000*	30.72		1.2	1.2	1.1	1.0	0.9	0.9
S	Total Lease Line Revenue ($ Millions)= *M+N+P+Q+R*			**16.3**	**15.4**	**14.4**	**13.4**	**12.4**	**11.4**
	Annual Revenue From Dial-up Service	Per Minute Tariff							
T	Number of Subscribers		*-6%*	20,738	19,614	18,557	17,563	16,630	15,752
	Per Subscriber Calculations:								
U	Long Distance Minutes Per Month = *C*D*			400	400	400	400	400	400
V	Local Minutes Per Month = *C*E*			400	400	400	400	400	400
W	Long Distance Revenue ($ Millions)= *$0.12*L*T*U*12/1000000*	$ 0.12		11.9	11.0	10.0	9.2	8.4	7.7
X	Local Call Revenue ($ Millions)= *$0.015*L*T*V*12/1000000*	$ 0.015		1.5	1.4	1.3	1.2	1.1	1.0
Y	Annual Dial-up Service Revenue ($ Millions) = W+X			**13.4**	**12.3**	**11.3**	**10.4**	**9.5**	**8.7**
Z	**Total Revenue per Year ($ Millions) = S+Y**			**29.8**	**27.7**	**25.7**	**23.7**	**21.9**	**20.1**

Table 10-5: Summary of JVCo Revenue Projections Combined Markets ($ Millions)

	2001	2002	2003	2004	2005	2006	2007	2008
Commercial Market								
Lease Line	$ -	$ 1.0	$ 2.0	$ 8.8	$ 15.5	$ 22.0	$ 28.3	$ 34.0
Dial-up	-	-	0.9	4.8	9.9	16.3	24.2	33.6
Total	-	1.0	2.9	13.6	25.4	38.4	52.5	67.6
Railways Market								
Lease Line	16.3	16.3	16.3	15.4	14.4	13.4	12.4	11.4
Dial-up	15.0	14.2	13.4	12.3	11.3	10.4	9.5	8.7
Total	31.4	30.5	29.8	27.7	25.7	23.7	21.9	20.1
Total of Both Markets	**$ 31.4**	**$ 31.5**	**$ 32.7**	**$ 41.3**	**$ 51.1**	**$ 62.1**	**$ 74.4**	**$ 87.7**
Percentage of Revenues								
Commercial	0%	3%	9%	33%	50%	62%	71%	77%
Railways	100%	97%	91%	67%	50%	38%	29%	23%



SECTION 11:
RECOMMENDED JOINT VENTURE STRUCTURE AND FINANCIAL PERFORMANCE

In this Section we discuss the proposed joint venture framework, the projected financial performance of the proposed joint venture company, and the assumptions on which these projections are made.

A. JOINT VENTURE FRAMEWORK

A number of alternative approaches and structures were evaluated to exploit the market potential of the Railway's new fiber optic ISDN network. This analysis was based on fulfilling three overlapping general objectives:

- Provide modern and reliable telecommunications services to serve the internal needs of the Railway companies and departments;
- Establish a separate, profit making entity to manage and market the Railway's telecommunications assets; and
- Market telecommunications services to potential non-Railway customers in Romania.

The recommended framework is illustrated in Figure 11-1. It comprises the following features:

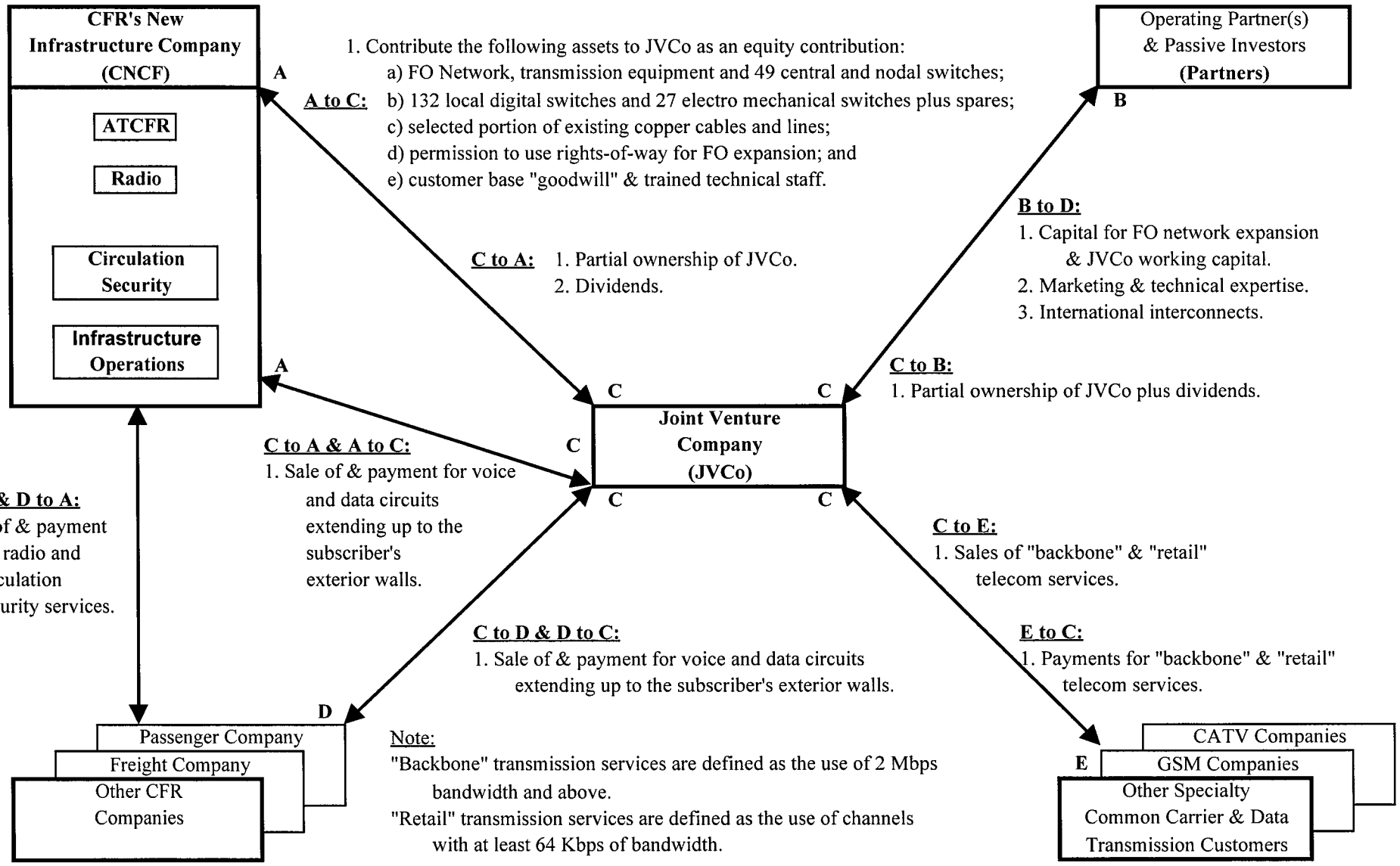
1) A new joint venture company (JVCo) partially owned by the newly formed Railway Infrastructure Company, CNCF, and one or more joint venture partners.

2) A contribution by CNCF of the following hard assets to JVCo:

   - The 20-fiber optic network, including the associated transmission and switching equipment described above;

Figure 11-1

Joint Venture Framework



- 27 existing electro-mechanical switches; and

- Sufficient copper cables and lines to serve the Railway's stations that are not on the fiber optic network. (As presented in Table 11-1, the total cost of the fiber optic network under the World Bank project is estimated to be $54.8 million, including SNCFR's internal costs. The existing electro-mechanical switches and copper cabling are obsolete and have been fully depreciated; thus, they have no value beyond their scrap value.)

Table 11-1: Cost of Fiber Optic Network

Project Components	Costs (US $ Millions)
Planning and Engineering	$2.3
Fiber Optic Cable (3,535 km)	$10.7
Cable Installation (3,535 km)	$9.7
Transmission Network (2-4 fiber pairs)	$12.7
Digital Switching Equipment (181 locations)	$12.8
Other Expenses and Contingencies	$1.2
Basic Investment	**$49.4**
Customs Taxes @ 15%	$5.4
Total with Customs Tax added	**$54.8**

3) A cadre of telecommunications maintenance and operating staff who have recently received extensive training in the new fiber optic network equipment;

4) Permission for JVCo to use the Railway's rights-of-way for the installation of additional fiber optics cable and equipment.

5) The contribution to JVCo of the business of providing telecommunications services to the five Railway Companies, which were newly formed in July 1998 and will be organized on free market, for-profit principles. The telecommunications services provided by JVCo for the Railway companies will not include radio or stand-by maintenance for circulation security.

6) More specifically, the customer base "goodwill" associated with the Railway's existing subscriber base of approximately 24,000 Railway employee subscribers plus approximately 7,000 outside subscribers. The outside subscribers comprise 2,000 important shippers that have business reasons to be connected to the Railway's telecommunications network plus 5,000 government officials who are located adjacent to the Railway facilities, e.g., custom agents. It is not clear how many of the latter outside subscribers would continue to use the telecommunications system if there is a fee; thus, explicit revenue from this source has not been used in our revenue calculations.

7) The provision by JVCo of telecommunications services directly or indirectly to non-Railway subscribers in accordance with the commercial marketing strategy developed by JVCo management.

8) Finally, the inclusion of investor(s) to provide proven talent in the management of commercial telecommunication companies and equity to fund the following phased investments:

- Installing additional plug-in cards in the transmission and switching equipment for the initial 10 fibers in accordance with the expansion of demand for telecommunications services;

- Installing transmission and switching equipment for the second set of 10 optical fibers as necessary to meet the demands of

the expanding Romanian market telecommunication services;

- Expanding the fiber optic network by approximately 1,800 kilometers to cover all of Romania's counties; and

- Providing sufficient funds for coverage of operating expenses during the startup of JVCo and for normal working capital needs of JVCo thereafter.

B. JVCo ORGANIZATIONAL STRUCTURE

The organizational structure of the contemplated JVCo will depend on the analyses and desires of JVCo's Board of Directors and management once the company is formed. The type and perspective of the joint venture partner(s) will heavily influence these decisions. Nevertheless, we have made preliminary projections concerning JVCo's organizational structure for the purpose of making pro forma financial projections.

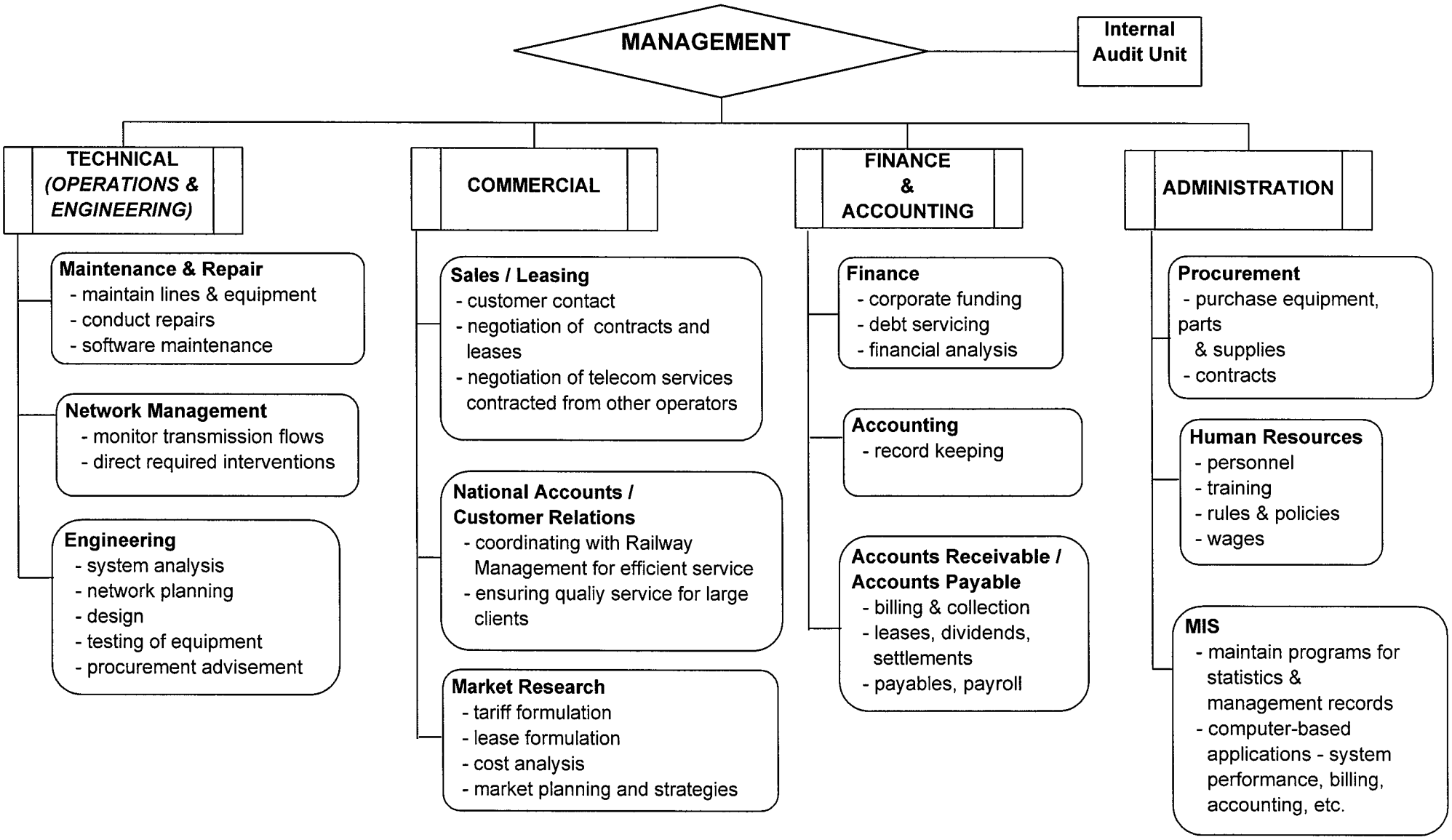
Figure 11-2 contains a functional organization chart for JVCo[10]. The contemplated organization will comprise four major departments - Technical, Commercial, Finance & Accounting, and Administration.

Technical Department will have responsibility over the telecommunications assets of JVCo and the personnel who are responsible for maintaining and operating them. Its purpose is to maintain, manage, and develop JVCo's telecommunications network. Three sections perform these functions.

- *Maintenance & Repair* will be responsible for ensuring that the telecommunications lines and equipment are

[10] This organizational chart is identical to the one for ATCFR presented in Section 6. This reflects the fact that ATCFR, coming first, shall likely be the "seed" from which JVCo will "sprout". We have recommended ATCFR be organized so as to be conducive for such a joint venture structure.

Figure 11-2: JVCo General Model - Central Level



maintained, needed repairs are performed, and equipment and software are functioning properly. It will coordinate a staff that will consist largely of traditional telecom skills, but with a component of trained new personnel for handling the digital equipment.

Supervision of the personnel responsible for maintaining the transmission and switching equipment will be located in Bucharest, Iasi, and Cluj. They will supervise the maintenance technicians who will be located in the field, operating out of trucks and, those located at the switches.

- *Network Management* will be responsible for monitoring the status of the network and its transmissions. System managers will re-route the system flows and direct the needed interventions on the system to ensure that it is operating properly and efficiently.

  Three network management centers are being established by the Railway in Bucharest, Iasi, and Cluj. Each of these centers will have the capability of assuming system-wide control for transmission in the event the other centers become inoperable.

- *Engineering* will be responsible for system analysis, system design, testing of equipment, and formulation of strategies for the technical development of the network. It is an internal resource for designing procurement documents involving technical specifications.

Commercial Department will be responsible for acquiring and retaining the subscribers needed to generate sufficient revenues for JVCo. It will develop contractual arrangements with the JVCo's clients, ensure good customer service, evaluate costing data, and develop recommended tariffs. It is divided into the following three sections:

- *Sales & Leasing* will contain the sales staff of the company. It will be responsible for selling to small and medium sized potential clients of JVCo. It will also be responsible for negotiating service contracts with other telecommunications operators.

- *National Accounts & Customer Relations* will be responsible for developing and retaining major national accounts, such as the Railways.

- *Market Research* will be responsible for formulating tariffs and lease prices based on cost analyses and competitive factors. This section will also be responsible for evaluating and formulating alternative market strategies

Finance & Accounting Department will be responsible for producing timely management information, installing financial controls, keeping financial records, and making and receiving payments. Its purpose is to manage and record JVCo's financial assets and transactions. It will consist of three sections:

- *Finance* will be responsible for obtaining sources of corporate funding, for managing loans and debt service, and for maintaining banking relationships and other typical financial functions.

- *Accounting* will be responsible for producing the financial statements of JVCo and making periodic financial reports for company management. In addition, it will perform traditional accounting functions required to maintain accurate corporate financial records and controls.

- *Accounts Receivable & Accounts Payable* will be responsible for billing and collecting service payments and leases. It will also manage collections and settlements with other telecommunications operators as well as payroll functions.

Administration Department will provide administrative support to the other Departments and Sections of JVCo. It will be responsible for keeping the company appropriately supplied, staffed, and informed. It will have the following three sections:

- *Management Information Systems (MIS)* will be responsible for developing systems and programs for maintaining the statistical and management-related records, and for procuring and operating computer equipment.

- *Procurement* will be responsible for purchasing the equipment, parts, and supplies required by JVCo.

- *Human Resources* will be responsible for coordinating recruitment and training of personnel, producing company personnel policies, training, managing personnel records, and setting wage guidelines.

C. PROJECTED STAFFING LEVELS AND OPERATING COSTS

As detailed in Table 11-2, JVCo's initial staffing level is projected to be 856 employees, and its initial annual operating costs are projected to total $13.6 million. These initial staffing levels and operating cost projections are based on the following assumptions for the year 2001:

- Initially, JVCo will provide 24,000 subscriber lines for the newly formed Railway Companies plus 2,000 subscriber lines connected to major shippers who desire access to the Railway's telecommunication network. Starting in the year 2000, we have assumed that demand for Railway subscriber lines will decrease by 6% per year as a result of anticipated staff reductions during the next decade.

- JVCo will begin a focused marketing effort to attract lease line customers.

Table 11-2 also contains pro forma estimates of staffing levels and annual operating costs for the year 2008 under the following assumptions:

- JVCo continues to provide telecommunication services to Railway subscribers, but the number of Railway subscribers has decreased from 24,000 to below 16,000 as a result of cost reduction programs undertaken by the Railway Companies.

- JVCo sells approximately 64,000 dial-up subscriber lines to outside business customers.

- JVCo sells approximately 1,500 dedicated lease lines to local telecommunication access providers, GSM companies, Internet providers, and major customers. The bandwidth for half of the lines is 2Mbps and for the other half 64Kbps.

- Projected annual operating costs are expressed in terms of constant US Dollars. (i.e., Lei to Dollar exchange rate is assumed to be adjusted at frequent intervals to properly reflect the inflation rate in Romania.)

Table 11-2: JVCo Operating Costs Projections Summary

Cost Category	2001 Start-up	2008 Full Telecommunications Service
Payroll		
Number of Employees	856	1058
Total Cost ($ Million)	6.32	16.36
Supplies & Materials	2.30	2.64
Equipment Rental	4.76	4.81
Advertising	.24	.24
TOTAL ($ Million)	13.62	24.05

D. COST OF EXPANDING THE FIBER OPTIC NETWORK

Although there is substantial slack capacity in the initial "lighted-up" fiber optic pairs and transmission equipment, the beginning switching equipment configuration (Configuration I) has been sized to serve the 26,000 railway subscribers (including 2,000 major shippers) plus about 7,000 additional outside subscribers. Figure 5-1 (on page 98) contains a map that depicts the Configuration I geographical layout.

An investment of approximately $504 per subscriber in switch capacity will be required to connect additional business *dial-up* subscribers beyond the initial 33,000-subscriber level.[11]

The STM 16 portion of the Configuration I network (the Central and Southeastern Rings) has a theoretical transmission capacity of approximately 1,000 2 Mbps channels or 30,000 64 Kbps channels. The STM 4 portion of the Configuration I network (the Northern, Northeastern, and Bucharest rings) have a theoretical transmission capacity equal to 25% of these amounts.

Configuration II is a preliminary design approach to doubling the network transmission capacity by "lighting up" two additional pairs for each ring, but making no changes in the branch line transmission equipment. The estimated marginal cost of installing Configuration II transmission equipment totals $25.3 million including for 15% customs duty and $2.2 million for planning, engineering, and contingency. This transmission capacity increase, however, may be phased-in over several years. This project is likely to start after increasing the size of the network as described below under Configuration III. The general design assumption, on which the Configuration II investment cost estimates are based, is that an additional STM 16 fiber optics pair and a STM 1 pair, plus associated multiplex equipment is installed on each of the ten Configuration I and III rings. No additional transmission capacity will be installed for the branch lines.

Configuration III is a preliminary design approach to expanding the size of the network by 1,815 kilometers. As detailed in Table 11-3, the estimated cost of

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[11] The $504 investment estimate is based on the assumption that JVCo personnel would be primarily responsible for installing the incremental switching capacity. A crew of 26 people have been included in the staffing estimates to perform this activity.

installing the Configuration III network expansion totals $22.3 million. This expansion may also be phased in over several years. Once the expansion is completed, however, the network will extend to each of Romania's 42 counties, and 87% of the network's route-kilometers will be included in one of ten rings.

Table 11-3: Capital Investment for 1,815 km Network Extension

Project Component	Cost (US $ Millions)
Project development costs	$1.0
Fiber optic cable (1,238 km aerial; 577 km underground)	$10.5
Digital transmission network (STM-16; STM-4; STM-1; multiplexers; network management; synchronization; etc.)	$4.9
HDSL Equipment (177 pieces)	$0.3
Other expenses (Const. Mgt.; taxes, commissions, 10% contingencies	$2.5
Customs taxes	$1.6
Total cost of extension	**$20.8**

Basis: Constant 1998 US$; Lei converted @ 8500 = 1 US$

Figure 5-2 (page 103) contains a map that depicts the combined Configuration I and III geographical layout.

E. MARKETING STRATEGIES FOR JVCo MARKETS

Essentially, the market for telecommunications services is divided into two periods or phases. Phase 1 covers the period until the end of December 2002, and Phase 2 covers the period following December 2002, when the market for telecommunications services will be fully open to competition. During Phase 1, only Rom Telecom can offer domestic or international telephone services to the public. Therefore, JVCo will be limited to the following terrestrial market segments in Phase 1:

- Data transmission services to any type of customer;

- Internal telecommunications services to major institutions, such as the Railways, the electric power companies, etc.; and

- Internal backbone communication services for GSM, VSAT, and Internet licensed operators.

During Phase 2, JVCo is legally permitted to market telecommunications services to any market segment.

It is difficult to develop reliable estimates of the present market size and future potential for various segments of the Romanian telecommunications market. At present, there is limited published data, and the structure and growth patterns of various segments of the telecommunications market are likely to change substantially following deregulation at the end of 2002. Nevertheless, some general findings can be made and conclusions reached based on the publicly available data and on selected interviews with a limited number of present independent providers of telecommunication services.

Rom Telecom reports that in 1996[12] it served 3.1 million subscriber lines with a penetration rate of 13.8 %. Rom Telecom's approved initial expansion plans called for the addition of between 150,000 and 200,000 lines per year, an annual increase of approximately 5.5%. If Rom Telecom has met its short-term expansion schedule of 170,000 lines per year, the number of installed subscriber lines at the end of 1998 will be 3.5 million, resulting in a penetration rate of 15.4%. If Rom Telecom and other newly formed telecommunication providers are able to install an average of 200,000 new local subscriber lines per year between 1998 and 2008, the installed subscriber base will be 4.5 million lines in 2003 and 5.5 million lines in 2008. The resulting penetration rate would then be 24% in 2008.[13]

The more profitable market for telecommunications services is the business user. Compared to residential customers, businesses have much greater telephone usage, volume of long-distance and international calls, and demand for data transmission-

[12] 1996 is the latest year for which published Rom Telecom data is available.

[13] The population of Romania is expected to increase by only 2% between 1998 and 2008

related services. On the other hand, Rom Telecom reported for 1996 that its business sector comprised only 11.3% of its total telephone subscribers. As was shown in Table 10-1, this percentage of business lines is lower than any other Central and Eastern European country. This indicates a potential untapped market. In fact, because of the potential for increase in the market size for the business customer and the higher average revenue generated from these customers, JVCo should focus its marketing efforts on the business sector.

There are a number of marketing strategies that can be adopted by JVCo. Naturally, the decision as to which of these strategies to adopt will be made by JVCo's Board and management. TERA suggests the following three-part marketing strategy for evaluating the financial prospects of JVCo - (1) marketing of leased lines of varying bandwidths, (2) providing outsourcing telecommunication services to major users in addition to the Railway Companies, and (3) providing dial-up long distance services directly to business customers.

Market Outlook for Dedicated Lease Line Service

JVCo would market point-to-point dedicated-line service throughout Romania. Until now, the market potential for dedicated lines has been small. Rom Telecom's revenues from this source were slightly under $10 million in 1995 and 1996. This is likely to change substantially in the next few years. Several independent operators are now providing inter-urban data transmission services to banks and other large commercial companies who have daily requirements to transmit data among multiple offices. At present, these operators are leasing lines from Rom Telecom or using satellite communication channels. The independent operators that were interviewed reported the following:

- They were not satisfied with Rom Telecom's present level of service or pricing structure for leased lines.
- If price was somewhat equal, they would much prefer good quality terrestrial links to their present satellite links.
- They are planning to enter the voice telephony market immediately following the end of Rom Telecom's monopoly at the end of 2002.

Another potential well-financed customer has received permission and frequency assignments to provide local wireless loop services for many of the principal cities in Romania.

In addition, most of the Romanian CATV operators plan to provide local Internet service via their local cable network. There is an interest on the part of many of these operators to form a cooperative of some sort that would install a single high capacity satellite dish to serve their collective international Internet communication requirements. This cooperative would then need to lease terrestrial digital dedicated lines between the dish and their respective base stations, which are located throughout Romania.

The marketing of leased lines to carry commercial and Internet data can commence as soon as the JVCo is formed and Configuration I of the network is installed - (now scheduled for the year 2000).

Market Outlook for Outsourcing Services

JVCo's major source of revenue for its initial years will be from providing outsourcing telecommunication services to the Railway Companies. With its new ISDN fiber optic network, JVCo can also serve other large institutions. One possible candidate would be the newly formed RENEL Companies (power utilities), which would become both customers and partial owners of JVCo. Presumably, their equity position in JVCo would be based on the contributed value of their existing telecommunication facilities, permission to use their rights-of-way, and customer base "goodwill." The inclusion of a major institution as an outsourcing customer would have a substantial impact on the structure and financial performance of JVCo. Since the probability of this occurring is difficult to predict, however, we have ignored this possibility in our financial projections.

Outlook for Dial-up Line Services

Starting in 2003, JVCo will be permitted to market telecommunication lines to business customers that would carry both voice and data. Compared to dedicated line service, the market for dial-up service (i.e., switched service) is much larger. All businesses with a need for "dial-up" long-distance telephony or data transmission service will be potential consumers for this type of service.

There are two potential constraints, or problems, with this market segment. First, it is not clear at this time exactly how, and at what cost, JVCo will connect to Rom Telecom, who would still be responsible for providing the "last mile" service at both ends. Presumably, these arrangements will be settled during the months ahead. For the purposes of our financial projections, we have assumed that JVCo will pay a connect charge to Rom Telecom at both ends of the call equal to its local call tariff rate. Rom Telecom's present tariff rate for local call is 3 cents per minute; thus, the total payment to Rom Telecom for providing "last mile" connection is assumed to be 6 cents per minute.

The second constraint arises out of the fact that JVCo in serving dial-up business customers, would potentially be competing with its leased line customers indirectly. This may not be a serious problem, however, since the only other apparent source to supply terrestrial digital lines would be Rom Telecom, who also will be competing for the same customer base.

F. OUTLOOK FOR INCREASED RAILWAY TELECOMMUNICATIONS SERVICES

JVCo's initial telecommunication services for the Railways will comprise:

- Dial-up telephony services for the 24,000 Railway subscribers plus approximately 2,000 major shippers;
- Dedicated leased line service between Bucharest and the 1,334 railway stations to transmit pre-IRIS data; and
- Short distance dedicated leased lines between the 1,334 stations and their surrounding facilities.

In addition to the above initial services, there are anticipated future Railway systems which will provide other opportunities for marketing telecommunications services. One of these is a Passenger Reservations and Ticketing System (PRTS) which the Railway plans to install within the next few years. This will require approximately 200 dedicated 2 Mbps channels between Bucharest and servers located throughout Romania. Each of these servers will be connected to approximately 10 ticketing and reservation terminals using dedicated 64 Kbps

dedicated lines. To service this new telecommunications requirement, an additional telecommunication investment in servers of approximately $1 million will be required.

Two future systems that are anticipated but have not been included in our calculations due to various uncertainties in timing and configuration follows.

(1) The Railway is in the process of developing and installing an integrated computer based, operating information system (IRIS) for transportation, maintenance, and fixed asset management. The Railway has received funding from the World Bank and has selected vendors for this undertaking, but physical installation of the finished system will not be completed for several years. To service IRIS, a telecommunication investment will be required that is similar in magnitude to the anticipated PRTS investment. Since IRIS is not yet defined, neither the new investment in telecommunication facilities nor the revenue from IRIS dedicated lines is included in the present JVCo revenue and financial projections.

(2) The installation of a GSM-R network along the Railway's right-of-way is still further in the future. This system will be both a major source of JVCo revenue and require substantial investment in base station transmission equipment. Several years ago the European railways began the development of specifications for a European Integrated Radio Enhanced Network (EIRENE). This process has been substantially completed and trial installations are undergoing tests on the German Railways. The objective of EIRENE is to provide a standard means of communicating voice and data among track-side base stations, train crews, shunting engine crews, train passengers, and others for all of the European Railways. The European Railways have adopted GSM technology for this purpose, and selected the frequency bands of 876 to 880 MHz (uplink) and 921 to 925 MHz (downlink).

It is likely that the Romanian Railways will decide to install this system sometime during the first decade of the next Century. If the GSM-R system is initially installed along the important rights-of-way, this will require the following:

- The dedication of high capacity communication channels (2 Mbps or higher) for 3,600 route kilometers;

- Installation of base station radios at approximately 309 locations; and

- Installation of new radio equipment in locomotives and passenger coaches.

It is not clear at this time what portions of the investment will be the responsibility of the JVCo and the Railways. Nor is it clear how the potential revenue from passengers using the system will be allocated. Thus, neither the GSM-R investment nor revenue has been included in the present JVCo revenue and financial projections.

G. FINANCIAL PROJECTIONS

JVCo's financial projections are summarized in Tables 11-5 through 11-9. They are based on two alternate assumptions. Alternative A assumes that the only equity contribution to JVCo is $54.8 million which represents the cost of the fiber optics network by CNCF and that JVCo borrows short term money for the first few years to cover negative cash flows and to pay dividends to CNCF so that it can pay the required debt service for the World Bank loan. Alternative B assumes that a capital contribution of $20 million is made to JVCo so that no short term borrowing is required.

- Table 11-5: JVCo Projections of Investments in Fixed Assets contains projected capital requirements by year for: (i) additional switching equipment needed to the year 2012; (ii) doubling of the transmission capacity of the network, (iii) the 1,815 kilometer extension of the fiber optics network through the year 2003, (iv) a pre-IRIS network, (v) a local satellite network for the railway stations, and (vi) a communications network to serve the new PRTS system.

Table 11-5: JVCo Projections of Investments in Fixed Assets - Alternatives A and B

All Dollar figures except for Switch Unit Costs are in millions of US Dollars.

	Project Investm't	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Initial FO Network	$ 54.8	$ 54.8												
Switch Investments: (number of Lines)														
Dial-up Customers			0	0	1,463	7,995	17,502	29,090	44,600	64,103	83,606	103,109	122,612	142,115
Railway Customers			23,206	21,934	20,738	19,614	18,557	17,563	16,630	15,752	14,874	13,996	13,118	12,240
Total			23,206	21,934	22,201	27,609	36,059	46,653	61,230	79,855	98,480	117,105	135,730	154,355
Base Capacity			33,200	33,200	33,200	33,200	33,200	33,200	33,200	33,200	33,200	33,200	33,200	33,200
Additional Capacity Needed			0	0	0	0	2,859	13,453	28,030	46,655	65,280	83,905	102,530	121,155
Switch Capacity Increase			0	0	0	2,859	10,594	14,577	18,625	18,625	18,625	18,625	18,625	
Switch Capacity Investment @ $ 504 per Line * Capacity	$ 504		$ -	$ -	$ -	$ 1.4	$ 5.3	$ 7.3	$ 9.4	$ 9.4	$ 9.4	$ 9.4	$ 9.4	$ 9.4
PRTS Network														
Percent Completion			100%											
Project Investment	$ 1.0	$ -	$ 1.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1815 Km Extension:														
Percent Completion			10%	50%	40%									
Project Investment	$ 22.3	$ -	$ 2.2	$ 11.2	$ 8.9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
10 Fiber Project:														
Percent Completion						0%	33%	33%	33%					
Project Investment	$ 25.3	$ -	$ -	$ -	$ -	$ -	$ 8.4	$ 8.4	$ 8.4	$ -	$ -	$ -	$ -	$ -
Miscellaneous Investments		$ -	$ 2.0	$ 1.0	$ 1.0	$ 1.0	$ 1.0	$ 1.0	$ 1.0	$ 1.0	$ 1.0	$ 1.0	$ 1.0	$ 1.0
Total Investments Requirements		**$ 54.8**	**$ 5.2**	**$ 12.2**	**$ 9.9**	**$ 2.4**	**$ 14.8**	**$ 16.8**	**$ 18.8**	**$ 10.4**	**$ 10.4**	**$ 10.4**	**$ 10.4**	**$ 10.4**

- Tables 11-6 and 11-7: Projected JVCo Profit & Loss Statements and Balance Sheets - Alternatives A and B, respectively contain projected integrated profit & loss statements and year-end balance sheets starting with year-end balance sheet for the year 2000 and ending with the 2008 ending balance sheet under Alternatives A and B assumptions.

- Table 11-8 and 11-9: JVCo Cash Flow Projections - Alternative A and B, respectively contains estimated cash flow projections for the years 2001 through 2012 for Alternatives A and B assumptions.

Each of these tables is expressed in constant US Dollars. It is assumed that changes in the Romanian Lei to Dollar conversion rate will roughly parallel the Romanian inflation rate. Although there will undoubtedly be at least some inflation rate for the US Dollar during the next ten years, telecommunication equipment is more likely to decrease rather than increase in price during this period. In other words, we have assumed that the potential increase in Dollar operating costs will be offset by the anticipated decrease in future Dollar investment requirements.

The following paragraphs discuss the specific assumptions on which these five tables are based.

JVCo Projections of Investments in Fixed Assets

As discussed earlier, the initial fiber optics network has sufficient capacity to handle approximately 33,000 subscriber lines. The cost of adding switch capacity for dial-up lines beyond the 33,000-line base is estimated to be $504 per line. Based on the assumptions contained in Table 10-4, the Railway Companies are estimated to require 26, 000 lines (24,000 for the Railway and 2,000 for major shippers) in 1999. Beginning in 2000, we have assumed that reductions of 6% per year in both employees and Railway subscriber lines will be made by the Railway Companies to bring their labor productivity more in line with other similar railways.

Based on other assumptions contained in Table 10-3, the number of commercial dial-up line subscribers are projected to increase from about 1,500 for the year

Table 11-6: Projected JVCo Profit & Loss Statements and Balance Sheets - Alternative A (US$ Millions)

	2000	2001		2002		2003		2004		2005		2006		2007		2008	
P&L Statements:																	
Revenue:																	
Railways		$ 31.4	100%	$ 30.5	97%	$ 29.8	91%	$ 27.7	67%	$ 25.7	50%	$ 23.7	38%	$ 21.9	29%	$ 20.1	23%
Commercial		0.0	0%	1.0	3%	2.9	9%	13.6	33%	25.4	50%	38.4	62%	52.5	71%	67.6	77%
Subtotal		31.4	100%	31.5	100%	32.7	100%	41.3	100%	51.1	100%	62.1	100%	74.4	100%	87.7	100%
Operating Costs:																	
Labor		6.3	20%	7.7	25%	9.2	28%	10.6	26%	12.1	24%	13.5	22%	15.0	20%	16.4	19%
Material & Services		7.3	23%	7.4	23%	7.4	23%	7.5	18%	7.5	15%	7.6	12%	7.6	10%	7.7	9%
Depreciation		2.7	9%	3.0	10%	3.6	11%	4.1	10%	4.2	8%	5.0	8%	5.8	8%	6.7	8%
Interest		0.6	2%	0.4	1%	0.9	3%	1.2	3%	0.4	1%	0.4	1%	0.0	0%	0.0	0%
Subtotal		17.0	54%	18.5	59%	21.1	64%	23.4	57%	24.3	48%	26.5	43%	28.4	38%	30.8	35%
Profit before Taxes		14.4	46%	13.1	41%	11.6	36%	17.9	43%	26.8	52%	35.7	57%	46.0	62%	56.9	65%
Corporate Taxes		5.5	17%	5.0	16%	4.4	13%	6.8	16%	10.2	20%	13.5	22%	17.5	23%	21.6	25%
Profit after Taxes		**$ 8.9**	**28%**	**$ 8.1**	**26%**	**$ 7.2**	**23%**	**$ 11.1**	**35%**	**$ 16.6**	**53%**	**$ 22.1**	**70%**	**$ 28.5**	**91%**	**$ 35.3**	40%
Capital Transactions:																	
Equipment Investments	54.8	5.2		12.2		9.9		2.4		14.8		16.8		18.8		10.4	
Equity Contributions	0.0																
Dividends to Service World Bank Loan		3.8		3.8		3.8		3.8		3.8		3.8		3.8		3.8	
Year End Balance Sheets																	
Assets:																	
Cash	0.0	0.0		0.0		0.0		0.0		0.0		0.2		9.4		34.6	
Net Working Capital	6.3	6.3		6.3		6.5		8.3		10.2		12.4		14.9		17.5	
Fixed Assets	54.8	60.0		72.2		82.1		84.5		99.3		116.1		134.9		145.3	
Less: Depreciation	0.0	2.7		5.7		9.4		13.5		17.7		22.6		28.5		35.2	
Net Fixed Assets	54.8	57.3		66.4		72.7		71.1		81.6		93.4		106.5		110.1	
Total Assets	61.1	63.6		72.7		79.3		79.3		91.8		106.0		130.7		162.2	
Liabilities & Networth:																	
Debt	6.3	3.6		8.5		11.7		4.4		4.1		0.0		0.0		0.0	
Networth	54.8	59.9		64.2		67.6		74.9		87.7		106.0		130.7		162.2	
Total Liabilities	61.1	63.6		72.7		79.3		79.3		91.8		106.0		130.7		162.2	

Assumptions: Wrk'g. Capital % of Sales 20% Depreciable Life 20 Yrs. ; Corporate Income Tax Rate 38% ; Debt Interest Rate: 10%

Table 11-7: Projected JVCo Profit & Loss Statements and Balance Sheets - Alternative B (US$ Millions)

	2000	2001		2002		2003		2004		2005		2006		2007		2008	
P&L Statements:																	
Revenue:																	
Railways		$ 31.4	100%	$ 30.5	97%	$ 29.8	91%	$ 27.7	67%	$ 25.7	50%	$ 23.7	38%	$ 21.9	29%	$ 20.1	23%
Commercial		-	0%	1.0	3%	2.9	9%	13.6	33%	25.4	50%	38.4	62%	52.5	71%	67.6	77%
Subtotal		31.4	100%	31.5	100%	32.7	100%	41.3	100%	51.1	100%	62.1	100%	74.4	100%	87.7	100%
Operating Costs:																	
Labor		6.3	20%	7.7	25%	9.2	28%	10.6	26%	12.1	24%	13.5	22%	15.0	20%	16.4	19%
Material & Services		7.3	23%	7.4	23%	7.4	23%	7.5	18%	7.5	15%	7.6	12%	7.6	10%	7.7	9%
Depreciation		2.7	9%	3.0	10%	3.6	11%	4.1	10%	4.2	8%	5.0	8%	5.8	8%	6.7	8%
Interest		0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
Subtotal		16.3	52%	18.1	57%	20.2	62%	22.2	54%	23.8	47%	26.1	42%	28.4	38%	30.8	35%
Profit before Taxes		15.0	48%	13.4	43%	12.5	38%	19.0	46%	27.2	53%	36.1	58%	46.0	62%	56.9	65%
Corporate Taxes		5.7	18%	5.1	16%	4.7	14%	7.2	18%	10.3	20%	13.7	22%	17.5	23%	21.6	25%
Profit after Taxes		**$ 9.3**	30%	**$ 8.3**	26%	**$ 7.7**	24%	**$ 11.8**	29%	**$ 16.9**	33%	**$ 22.4**	36%	**$ 28.5**	38%	**$ 35.3**	40%
Capital Transactions:																	
Equipment Investments	54.8	5.2		12.2		9.9		2.4		14.8		16.8		18.8		10.4	
Equity Contributions	20.0																
Dividends to Service World Bank Loan		3.8		3.8		3.8		3.8		3.8		3.8		3.8		3.8	
Year End Balance Sheets																	
Assets:																	
Cash	13.7	16.8		12.1		9.5		17.4		18.0		22.6		31.8		56.9	
Net Working Capital	6.3	6.3		6.3		6.5		8.3		10.2		12.4		14.9		17.5	
Fixed Assets	54.8	60.0		72.2		82.1		84.5		99.3		116.1		134.9		145.3	
Less: Depreciation	0.0	2.7		5.7		9.4		13.5		17.7		22.6		28.5		35.2	
Net Fixed Assets	54.8	57.3		66.4		72.7		71.1		81.6		93.4		106.5		110.1	
Total Assets	74.8	80.3		84.8		88.8		96.8		109.9		128.4		153.1		184.6	
Liabilities & Networth:																	
Debt	0.0	0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Networth	74.8	80.3		84.8		88.8		96.8		109.9		128.4		153.1		184.6	
Total Libilities	74.8	80.3		84.8		88.8		96.8		109.9		128.4		153.1		184.6	

Assumptions: Wrk'g. Capital % of Sales 20% Depreciable Life 20 Yrs. ; Corporate Income Tax Rate 38% ; Debt Interest Rate: 10%

Table 11-8: JVCo Cash Flow Projections - Alternative A (US$ Millions)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Profit & Loss:													
Revenue		31.4	31.5	32.7	41.3	51.1	62.1	74.4	87.7	101.0	114.4	127.7	141.0
Operating Costs		17.0	18.5	21.1	23.4	24.3	26.5	28.4	30.8	33.3	35.7	38.2	40.6
Profit Before Taxes		14.4	13.1	11.6	17.9	26.8	35.7	46.0	56.9	67.7	78.6	89.5	100.4
Corporate Taxes		5.5	5.0	4.4	6.8	10.2	13.5	17.5	21.6	25.7	29.9	34.0	38.1
Profit After Taxes		8.9	8.1	7.2	11.1	16.6	22.1	28.5	35.3	42.0	48.7	55.5	62.2
Capital Expenditures:													
Initial FO Network	54.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Switch Capacity	0.0	0.0	0.0	0.0	1.4	5.3	7.3	9.4	9.4	9.4	9.4	9.4	9.4
PRTS Network	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1815 Km Extension	0.0	2.2	11.2	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 Fiber Project	0.0	0.0	0.0	0.0	0.0	8.4	8.4	8.4	0.0	0.0	0.0	0.0	0.0
Miscellaneous	0.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Subtotal	54.8	5.2	12.2	9.9	2.4	14.8	16.8	18.8	10.4	10.4	10.4	10.4	10.4
Cash Capital Contribution	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Depreciation	0.0	2.7	3.0	3.6	4.1	4.2	5.0	5.8	6.7	7.3	7.8	8.3	8.8
Net Cash Flow:	**$ (54.8)**	**6.4**	**-1.0**	**0.9**	**12.7**	**6.1**	**10.3**	**15.5**	**31.6**	**38.9**	**46.1**	**53.4**	**60.7**
Dividends to Service World Bank Loan		3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Net Cash Flow after Dividends		**2.6**	**-4.8**	**-2.9**	**8.9**	**2.3**	**6.5**	**11.7**	**27.8**	**35.1**	**42.3**	**49.6**	**56.9**
Internal Rate of Return		**26%**											

Table 11-9: JVCo Cash Flow Projections - Alternative B (US$ Millions)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Profit & Loss:													
Revenue		31.4	31.5	32.7	41.3	51.1	62.1	74.4	87.7	101.0	114.4	127.7	141.0
Operating Costs		16.3	18.5	21.1	23.4	24.3	26.5	28.4	30.8	33.3	35.7	38.2	40.6
Profit Before Taxes		15.0	13.1	11.6	17.9	26.8	35.7	46.0	56.9	67.7	78.6	89.5	100.4
Corporate Taxes		5.7	5.0	4.4	6.8	10.2	13.5	17.5	21.6	25.7	29.9	34.0	38.1
Profit After Taxes		9.3	8.1	7.2	11.1	16.6	22.1	28.5	35.3	42.0	48.7	55.5	62.2
Capital Expenditures:													
Initial FO Network	54.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Switch Capacity	0.0	0.0	0.0	0.0	1.4	5.3	7.3	9.4	9.4	9.4	9.4	9.4	9.4
PRTS Network	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1815 Km Extension	0.0	2.2	11.2	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 Fiber Project	0.0	0.0	0.0	0.0	0.0	8.4	8.4	8.4	0.0	0.0	0.0	0.0	0.0
Miscellaneous	0.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Subtotal	54.8	5.2	12.2	9.9	2.4	14.8	16.8	18.8	10.4	10.4	10.4	10.4	10.4
Cash Capital Contribution	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Depreciation	0.0	2.7	3.0	3.6	4.1	4.2	5.0	5.8	6.7	7.3	7.8	8.3	8.8
Net Cash Flow:	**$ (74.8)**	**6.8**	**-1.0**	**0.9**	**12.7**	**6.1**	**10.3**	**15.5**	**31.6**	**38.9**	**46.1**	**53.4**	**60.7**
Dividends to Service World Bank Loan		3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Net Cash Flow after Dividends		**3.0**	**-4.8**	**-2.9**	**8.9**	**2.3**	**6.5**	**11.7**	**27.8**	**35.1**	**42.3**	**49.6**	**56.9**
Internal Rate of Return	**22%**												

2003 to slightly more than 64,000 in 2008. If the annual growth projected for 2008 continues for the subsequent four years, the number of dial-up customers will be more than 142,000 for the year 2012.

We believe that it will be important for JVCo to extend the network to cover all of Romania's 42 counties prior to the beginning of the open market in 2003. Thus, the $22.3 million investment to expand the network by 1,815 kilometers is scheduled to be disbursed in 2001 through 2003. The $25.3 million investment to double the network's transmission capacity expansion is scheduled to be disbursed in 2005 through 2007.

Projected JVCo Profit & Loss Statements and Balance Sheets - Alternatives A and B

The Alternative A and B profit & loss statements and balance sheets are based on the following assumptions:

- JVCo's revenue projections are based on Tables 10-3 and 10-4, and the operating cost projections are based on Table 11-2.
- Depreciation is based on an average 20-year life for all fixed assets.
- Corporate Income Tax Rate is assumed to be 38%.
- The $54.8 million cost of the initial fiber optics network, including customs duties, is contributed to JVCo as initial equity by CNCF to JVCo.
- CNCF will require an annual dividend of $3.8 million from JVCo through 2016 so that it has the funds to service the World Bank Loan.
- Under Alternative A:
  - JVCo will borrow sufficient short-term funds in US Dollars to cover its new cash requirements in 2001 through 2006.

- Interest rate on this borrowing is assumed to average 10%.

- Under Alternative B:

  - An initial outside investment of $20 million will be made in JVCo and no borrowing will be required.

Based on these assumptions, JVCo is profitable from the outset and becomes increasingly profitable starting in 2004. Under Alternative A, no allowance has been made for contingencies. Furthermore, there is no assurance that JVCo can obtain sufficient financing in US Dollars or other hard currency to permit dividends to be paid to CNCF in Dollars to service the World Bank Loan and to pay for needed imports of equipment.

Thus, under Alternative B, an initial capital contribution of $20 million is assumed so that no hard currency short-term borrowing is required.

JVCo Cash Flow Projections - Alternatives A and B

The net cash flow projections shown in Tables 11-8 and 11-9 are based on the proforma profit & loss statements and balance sheets contained in Tables 11-6 and 11-7 beginning with the year-end balance sheet for 2000. For the purpose of calculating the internal rate of return, these cash flow projections are extended beyond 2008 based on the following assumptions:

- The annual increase in JVCo revenue, costs, and profits between 2007 and 2008 and the annual investment requirement of $9.1 million are assumed to continue up through 2012.

- The 2012 net cash flow is assumed to continue indefinitely thereafter.

Based on these assumptions, the projected after tax internal rates of return are 26% for Alternative A and 22% for Alternative B.

H. SUMMARY

The revenue, cost and capital expenditure assumptions and projections appear reasonable and, in some cases, conservative. As is usually the case, the operating and capital cost projections are firmer than the revenue projections. Revenue figures depend on a prediction of an unknown future, while the cost figures can be at least partially controlled by JVCo management. Nevertheless, if the resulting magnitude of JVCo's revenues, operating costs, and investment calculations proves to be generally correct, JVCo should be a highly profitable telecommunications company.